DIO-ELECTRONIC ENGINEERING EDITION



# RADIO & TELEVISION NEWS

AUGUST 1953

HIS ISSUE

ED-CONSTANT
LAY LINES

RE TESTING OF
V TUBES

H-STABILITY
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TUNED
AVE REFLECTORS

REMOTE
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THE E-V REGENCY

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RECEIVERS

SIMPLE
UTTER CIRCUIT

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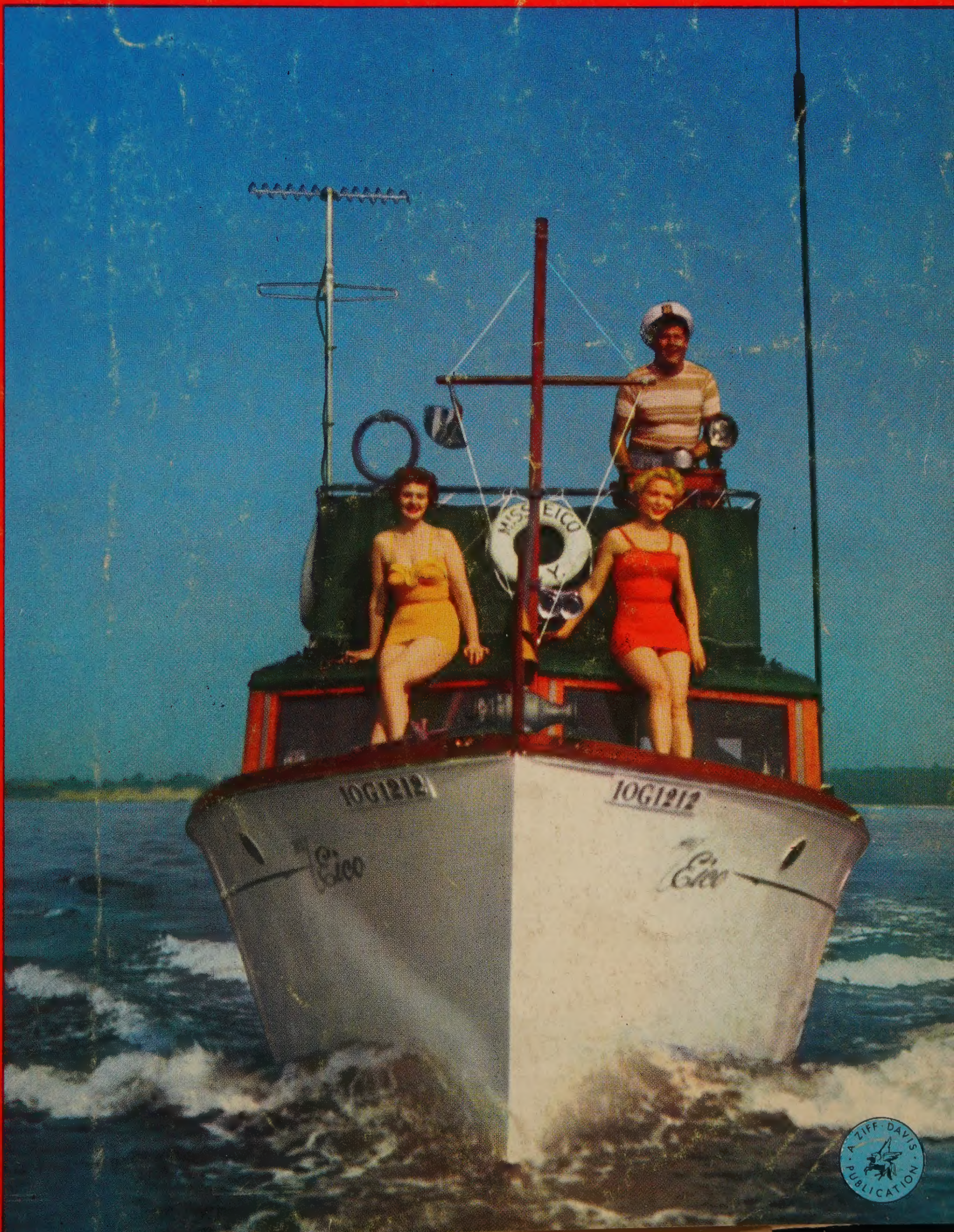


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An RCA Tube starts working for you from the instant the customer first sees the familiar red, black, and white carton. You have her confidence from the start, because she knows and respects the RCA trademark.

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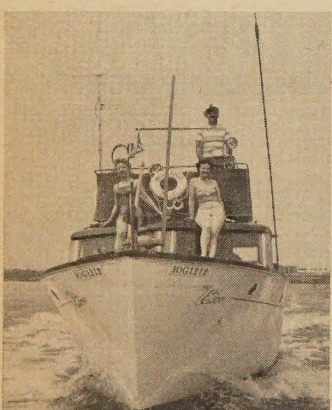

COVER PHOTO: The "Miss Eico", a 31-ft. motor launch carrying an extensive array of radio gear. The boat offers remote control of its radiotelephone system on the flying bridge. (Ektachrome by Jay Seymour)

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# RADIO & TELEVISION NEWS

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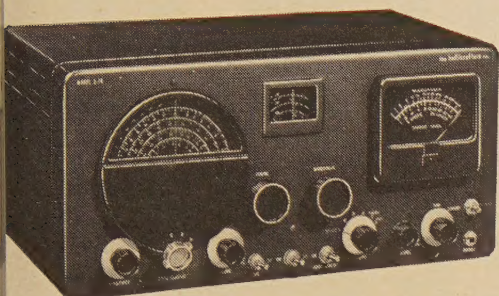
*Check the specs...*

*Check performance...*

# Then, They'll Choose Hallicrafters



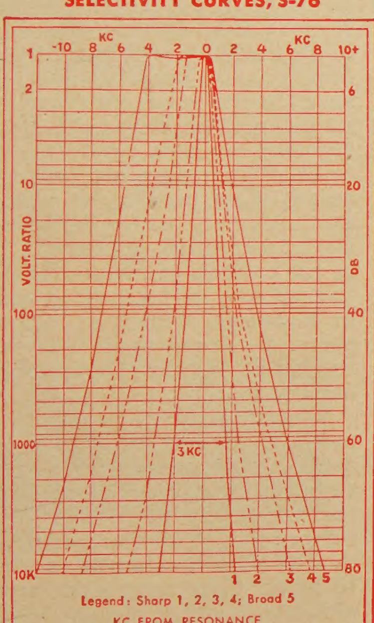
## Model S-76

Double conversion receiver. Broadcast Band 538-1580 kc plus three short-wave bands covering 1720 kc-34 Mc.

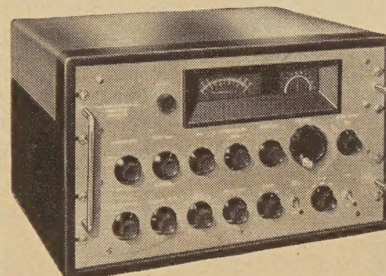
Calibrated electrical bandspread for easy tuning. Double superhet with 50 kc second i-f and giant 4-inch "S" meter. Five position selectivity, one r-f, two conversion, two i-f stages, temperature compensated. 3.2 or 500 ohm outputs.

Satin black steel cabinet. 18½" x 8⅞" x 9½" deep. Nine tubes, voltage regulator, and rectifier. For 105/125 V. 50/60 cycle AC. Use R-46 speaker. . . **$179.50**

**SELECTIVITY CURVES, S-76**




Do you know any better way, any other way, to judge SW equipment than to check the specifications and the performance? Frankly that's the only valid way we can think of to make sure you get your money's worth. Check these specs. Take a look at the selectivity curve for the S-76. It is typical of the outstanding value Hallicrafters offers in every price class.



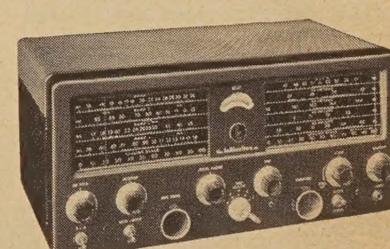
**Model HT-20.** T.V.I. suppressed 100 watt AM-CW transmitter with all spurious outputs above 40 Mc at least 90 db. below full rated output.

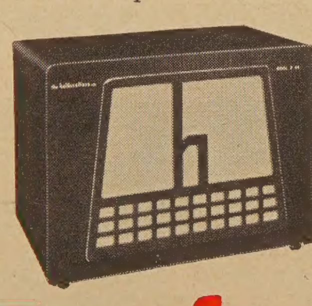
All stages metered; single meter with eight position meter switch; output tuning indication. Frequency range of 1.7 Mc to 31 Mc continuous on front panel control. Seven tubes plus five rectifiers. For 105/125 V. 50/60 cycle . . . . . . **$449.50**

**Model SX-71.** Covers Broadcast Band 535-1650 kc plus four short-wave bands covering 1650 kc-34 Mc. and 46-56 Mc.

Narrow Band FM one r-f, two conversion, and three i-f stages. Temperature compensated, voltage regulated. Three watt output (terminals for 500 and 3.2 ohms).

Satin black steel cabinet. 18½" x 8⅞" x 12" deep. 11 tubes plus regulator, rectifier. For 105/125 V. 50/60 cycle AC. Use R-46 speaker. . **$224.50**





**Model R-46.** Matching 10" PM speaker for use with Hallicrafters communications receivers SX-71, SX-76, SX-73 or SX-62. 80 to 5000 cycle range. Matching transformer with 500-ohm input. Speaker voice coil impedance, 3.2 ohms.

Satin black steel cabinet matches all Hallicrafters receivers. Cloth covered metal grille. 15" x 10⅞" x 10⅞" deep. Ship. wt. 17 lbs. . **$19.95**

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# *For the* RECORD

BY THE EDITOR

## ENGINEERING AND THE FUTURE

THE engineering profession, particularly in the electronics field, is riding at an all-time high. According to an analysis in a recent issue of the magazine *"U. S. News & World Report,"* college graduates in general and engineering graduates in particular were never in greater demand. Students and young people would do well to analyze their aptitudes and talents in the light of this demand and seriously consider entering the field.

A year ago, the Survey Committee of Engineers Joint Council indicated a shortage of about 80,000 engineers. This shortage is gradually being reduced but there is still a demand for about 42,000 engineers a year, and the total number of engineering graduates this year will probably not exceed 21,000. A similar situation holds true for scientists.

The present salary scales for graduate engineers would make the old-timers who graduated during the depression really drool. The starting scale runs roughly $350 a month, with extremes of as much as $500 being reported. This is for men with very little or no experience, just getting out of school.

These factors make engineering a very attractive and promising field. The long-term trend still favors the engineer and with the rapid developments in electronics and other fields, this trend may even be accelerated.

There are many other factors that make the engineering field attractive. Here is a chance to get in on the ground floor of some of the most startling developments of modern times. Here is a chance to satisfy one's inherent thirst for knowledge regarding the "why's" and "wherefore's" of scientific knowledge. Here is a chance to do something really constructive—increase the standard of living, develop something "new" that gives a feeling of accomplishment.

One of the questions asked of our readers in a recent survey dealt with the "special interests," including those readers attending classes in college and in trade school. We found as a result that a total of 61,673 were presently studying subjects in electronics. Nearly 24,000 of these readers were going to a trade school and another 20,000 were attending college. The survey showed that more than 24,000 were currently studying engineering and nearly 17,000 were studying communications. It has been most gratifying to the editors that ever since World War II there has been an ever-increasing number of high school graduates entering the field of engineering as a profession.

In addition to these men, we find that over 25,000 of our readers are studying servicing. While the total of the above is but a drop in the bucket compared to the requirements of the electronics industry, it does show that these students are greatly augmenting the entire engineering profession in our electronic industry.

Our high schools are doing an excellent job of training students to enter engineering colleges but still more must be done to cut down on the mortality rate. The analysis mentioned above reveals that many students are deficient in math. Others have not been taught to work and to think. These factors are of supreme importance to the engineer, and must be recognized early by engineering students. Probably the major reason for this is the shortage of good high school teachers who are able to inspire their students to think and work.

Another factor which is rapidly entering into the engineering field is that of executive ability and training. More and more of the larger companies are drawing from their engineering staffs to fill executive positions. This means even greater opportunities for engineers in the years to come. It also means greater responsibilities, more intensive training, and the development of aptitudes not ordinarily required in engineering as such. These aptitudes come under the broad heading of executive ability. It used to be the common impression that executive ability, or lack of it, was born in a person. However, it has been proved time and again that this ability can be developed to a remarkable degree.

What does all this add up to? It means that more and more of our students in high school and college should seriously consider entering one of the various engineering fields. It means further that these students must learn to discipline themselves to work and to think. They must learn how to get along with other people—how to organize and direct various activities—how to get the utmost in cooperation from associates—how to handle problems in human relations. More attention to the humanities can perhaps assist in this direction.

This might appear to be a difficult road to travel, but the rewards more than justify the difficulties. The feeling of satisfaction resulting from a job well done is worth many a tedious hour of study and preparation. . . O. R.

TAKES UP TO **21 in.** PICTURE TUBE

Leonard C. Lane, B.S., M.A. President of Radio-Television Training Association. Exec. Dir. of Pierce School of Radio and Television.

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Set up your own home laboratory with the 15 BIG TV-Radio kits we send you. You build AND KEEP your own complete BIG SCREEN TV RECEIVER, Super-Het Radio Receiver, R.F. Signal Generator, Combination Voltmeter-Ammeter-Ohmmeter, C-W Telephone Receiver, AC-DC Power Supply. Everything is furnished complete, including all tubes, plus big TV picture tube.

ET MORE!
LEARN MORE!
EARN MORE!

# THOUSANDS OF NEW JOBS IN TELEVISION

## I PREPARE YOU AT HOME IN YOUR SPARE TIME

## *IORE* AINING TO FIT YOU R THE BETTER PAY JOBS

ousands of new jobs will open up right your own state, now that the govern- nt has lifted restrictions on new TV ions. My simple, successful methods e helped hundreds of men — most of m with NO PREVIOUS TRAINING — places in America's booming TELE- ION and Electronics industries. You can get the success and happiness always wanted out of life within ths . . . studying at home . . . as I n you to become a full-fledged TV CHNICIAN. Many of my students make much as $25.00 a week repairing io-TV sets in their spare time while ning . . . pay their entire training al- t from the very beginning from spare e earnings . . . start their own profit- service business.

I don't stop after I qualify you as a Technician . . . although right there can choose from among dozens of inating careers! I continue to train — AT NO EXTRA COST — to qualify even better pay in the BETTER JOBS demand FCC licenses, with my . . .

## *MORE* VALUE!

### YOU GET A ROUND TRIP TO NEW YORK CITY AT NO EXTRA COST

FROM ANYWHERE IN THE U.S. OR CANADA — I pay your way to New York and return, PLUS 2 FREE weeks, 50 hours of advanced instruction and shop training at the PIERCE SCHOOL OF RADIO & TELEVISION. You use modern electronics equipment, including student-operated TV and Radio stations. You go behind the scenes of New York's big Radio-TV centers, to study first hand. And I give you all this AT NO EXTRA COST! (Applies to complete Radio-TV course only.)

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"I'm making good money in my own business, repairing and installing radio and TV sets — thanks to your training." — **Irwin Polansky**

"Your excellent instruction helped me get my present job as an airport radio mechanic for American Airlines. — **Eugene E. Basko**

"I'll always be grateful to your training which helped me get my present fine position as Assistant Parts Manager." — **Norman Weston**

**Many others working at NBC, RCA, CBS, DuMont, Philco, Emerson, Admiral and other leading firms.**

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you have previous Armed Forces or ilian radio experience—my ADVANCED URSE can save you months of training. ll theory and practical training . . . nplete with kits, including BIG SCREEN RECEIVER and FREE FCC License aching Course.

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vocational adviser will help you ob- n a good-paying job in the locality of ur choice.

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Dear Mr. Lane: Mail me your NEW FREE BOOK and SAMPLE LESSON that will show me how I can make BIG MONEY in TELEVISION. I understand I am under no obligation and no salesman will call.

(PLEASE PRINT PLAINLY)

Name ______ Age ____
Address ______
City ______ Zone ____ State ____

I am interested in: ☐ Radio-TV ☐ Advanced FM-TV.
**VETERANS:** If qualified under new G.I. Bill, check your choice: ☐ Home Study ☐ Resident Study.

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# Spot Radio News

★ **Presenting latest information on the Radio Industr**

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

COMPATIBLE COLOR, which dazzled members of Congress during that striking Princeton show, at this writing is being readied for a grandstand appearance before the seven guardians of the airlanes, the Commission, by the folks who staged the demonstration in New Jersey, *RCA*. Originally, the industry committee studying color was scheduled to file a petition as a body. Now, according to company spokesmen, two petitions may be filed, with the NTSC delaying its presentation until the late Fall.

The early prospects for color have so excited broadcasters, that over thirty affiliates of *RCA's NBC* net have signed affiliation contract supplements allowing them to carry colorcasts when the reds, greens, and blues begin coming over the coax. Among those who said yes, were WBRE-TV, Wilkes-Barre; WSYR-TV, Syracuse; WJAC-TV, Johnstown; WLWD, Dayton; WLWC, Columbus; WLWT, Cincinnati; WSAZ-TV, Huntington; WDSU-TV, New Orleans; KSTP-TV, St. Paul-Minneapolis; WKY-TV, Oklahoma City; KCBD-TV, Lubb WBAP-TV, Fort Worth; KPRC Houston, and KPTV, Portland.

According to the company's pro tion experts, setmaking should b about nine months after governn approval is received; thus sets *m* be available *next* Spring. Howe many have indicated, and q strongly, that the Winter of '54, p ably around Thanksgiving or Ch mas looks like a more realistic d line for color-chassis deliveries.

In the meantime, NTSC task gro are pushing ahead with their exh tive tests. Particularly active the field panels which have mem in New York, Chicago, Syrac Philadelphia, and Washington stantly probing and conducting ac observation tests. Not only are concerned with the effectivenes color reception, but the compatib of chassis for viewing and lister too. According to the test proced of one sub-committee, task groups responsible for official tests in st signal, intermediate strength sig

# NEW TV GRANTS SINCE FREEZE LIF

*Continuing the listing of construction permits granted by FCC sinc lifting of freeze. Additional stations will be carried next montl*

| STATE | CITY | CALL** | CHANNEL | FREQUENCY (mc.) | POWE (Video |
|---|---|---|---|---|---|
| Idaho | Meridian | ................ | 2 | 54-60 | 16. |
| Illinois | Rockford | ................ | 13 | 210-216 | 195 |
| Ohio | Cincinnati | WCIN-TV | 54 | 710-716 | 89 |
| Oregon | Eugene | ................ | 13 | 210-216 | 56 |
| Pennsylvania | Lancaster | ................ | 21 | 512-518 | 18 |
| Texas | Harlingen | ................ | 4 | 66-72 | 13 |
| " | Lubbock | KFYO-TV | 5 | 76-82 | 100 |
| Wyoming | Casper | KSPR-TV | 2 | 54-60 | 1. |
| Hawaii | Honolulu | ................ | 4 | 66-72 | 58 |

## REVISED CALL LETTER LISTING

**(Since the publication of the listings last month, the following final TV call letters have be assigned to new stations by the Commission.)**

| STATE | CITY | CALL | CHANNEL | FREQUENC |
|---|---|---|---|---|
| California | Fresno | KJEO | 47 | 668-674 |
| " | San Francisco | KSAN-TV | 32 | 578-584 |
| Florida | Lakeland | WOTV | 16 | 482-488 |
| Louisiana | Alexandria | KSPJ | 62 | 758-764 |
| Minnesota | Minneapolis | WTCN-TV | 11 | 198-204 |
| Michigan | Cadillac | WWTV | 13 | 210-216 |
| Missouri | Cape Girardeau | KGMO-TV | 18 | 494-500 |
| New Hampshire | Keene | WKNE-TV | 45 | 656-662 |
| Pennsylvania | Lancaster | WWLA | 21 | 512-518 |
| Tennessee | Knoxville | WCEE-TV | 26 | 542-548 |
| Texas | Victoria | KNAL-TV | 19 | 500-506 |

*ERP = (effective radiated power, kw.). **Call letters without TV suffix fro application files and subject to change; except where included in ca such as KKTV or WTVT. . . = Call letters to be announc

**WE BELIEVE** *Norman Foster's recent advertisement in the Chicago "TV Guide" is of interest to the entire television and radio industry. Consequently, with Mr. Foster's permission, we are reprinting it here as a public service for every television and radio service technician in America.*

Harry Kalker

(HARRY KALKER, President)

**SPRAGUE PRODUCTS COMPANY**

*(Distributors' Division of the Sprague Electric Company)*

North Adams, Massachusetts

NORMAN FOSTER

UNFORTUNATELY

# *Because of the Greed of a Few,*

## THE ENTIRE TV SERVICE INDUSTRY MUST SUFFER

## HERE IS WHAT I HAVE DONE TO GUARANTEE YOU HONEST TV SERVICE

The name, Foster Television is not taken from a street, a deck cards, or a country, and it is not an adjective. It comes from e name of its sole owner, Norman Foster. I have spent 22 years the Radio, Electronics and Television service business, and in ese years I have worked for just about every type of Operator, od, bad and indifferent. When the time came that I could open y own business, I decided that because of the reputation that e Radio and Television repair business has always had, a comny operating so honestly that they could invite their customers to the shop to watch their work being done could be a success. ie volume of business we did last year proves I was right.

The reason that a service man would attempt to sell you mething you do not need is because he had something to gain rsonally. Many Television service operators hire men, driving eir own cars, on a percentage basis. This is advantageous beuse the service company can be in business with practically no vestment. Under these conditions if this man needs money, only human nature that he is going to want to do the thing your television set that will make him the most money— hether it be 5 tubes or haul it to the shop.

Every man that I have, works by the hour and punches a time ock. He drives a company owned new truck bearing my name d his equipment and uniforms are furnished to him without arge. He has orders to repair your set in your home whenever ssible. He receives the same amount of money whether he reirs 1 set or 10, and whether he charges $1 or $10. His rate of y and his advancement are based on the number of sets he can pair in the home.

Our service call price is a flat $3 and covers all labor necessary make any repair possible in your home except cleaning a reen, for which we charge $1 extra. It is evident that on this sis we do not make money on every job, but with the large lume of business we do, it has averaged out to a modest profit the end of the year. You can bring your set into our shop and t only save this service charge, but also see it repaired while u wait. There is no minimum charge on this service. You pay ly for the actual time spent on your set.

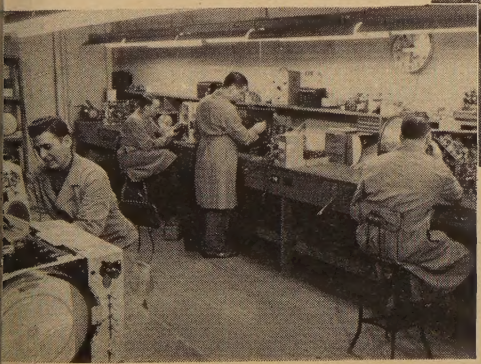
**5.** How fast can service be? I have a large fleet of trucks operating throughout Chicago from 9:30 A.M. to 11:00 P.M. I do not advertise one hour service and I do not believe that anything but a coincidence could give such fast service. Because it is impossible to predict in advance how long each job will take a man, the best we can do is to offer same day service. Occasionally at this time of the year, bad weather causing slow driving, makes it necessary to postpone calls received late, until the next day.

**6.** Quality of parts. I use only nationally advertised tubes and parts. Every tube I sell is new, fresh and cartoned, bearing a name and a date, and is coded by the manufacturer to indicate that it is a tube manufactured and guaranteed for replacement use. I do not use bulk or surplus tubes. Every picture tube I sell bears a serial number and has a factory registration certificate to guarantee that it is a new first quality tube. I do not sell rebuilt or rejuvenated picture tubes. I use only Sprague plastic sealed condensers, which are far superior to the parts used in many TV sets.

**7.** I guarantee every part I replace for 90 days. If a part or tube I have replaced fails, it is replaced at absolutely no charge to you. Our guarantee is further underwritten by the American Mutual Liability Insurance Co. by arrangement with the Raytheon Manufacturing Co.

**8.** I have not satisfied everybody and I do not claim to. I cannot repair a set that needs a new picture tube for $3 and I cannot give a $60 service contract with each call. Nothing less would satisfy certain people. However, if you hear a complaint against Foster Television, that same person will generally have one against the plumber, the auto mechanic, the dentist and nearly everyone else who is unfortunate enough to do business with him. I need and value your patronage and I will sincerely respect it.

Norman Foster

**Open 9:30 am-8:30 pm**

- **Home Service to 11 pm**
- **Sundays 11 am-3 pm**
- **HUmboldt 9-0911**

YOU CAN DEPEND ON **FOSTER TV**

2922 MILWAUKEE AVENUE

CHICAGO

and fringe signal areas. For the i-
termediate signal-strength tests, si-
nals between 3000 and 10,000 mic
volts are required.

In studying the signals, eight te
are made for resolution, over-all p
ture quality, flicker, brightness, co
trast, picture texture, adequacy
sync, and sound quality. The over-
picture quality report, it is said, r
veals the general impression a pictu
makes on the observer, and also
such defects as poor focus, streakin
beats, or noise, appear. In scrutin
ing picture texture, observers are r
quired to look for dot structure, c
crawl, moire, or beat patterns in t
picture. Viewers are warned that th
must look carefully to see if they re
ognize any limitations in subject ma
ter. They are also obliged to look f
evidence of brightening of the ho
zontal retrace lines due to presence
color sync signals, and make a reco
of such observations for several po
sible settings of the horizontal ho
control, with brightness control s
for best monochrome picture.

A novel scoring technique has be
prepared to permit an evaluation
observed results. Two scales are pr
vided, and a series of numbers fro
*one* to *six* to simplify identificatio
To illustrate, not perceptible repr
sents condition 1; just preceptible,
definitely perceptible, but not obje
tionable, 3; somewhat objectionab
4; definitely objectionable, 5; and n
usable, 6. In the second scale, whi
is complementary, 1 means exceller
2, good; 3, passable; 4, not quite pas
able; 5, poor; and 6, not usable.

The comprehensive tests also i
volve detailed studies of such pro
lems as susceptibility to co-chann
and adjacent-channel interference.
the former test, a lab signal generat
is modulated with a signal from
scanner or other pickup equipment
accordance with the NTSC propos
signal, and applied to a color set. Th
an interfering signal is applied
the set at a —40 db level. Signals a
non-sync, co-channel type and t
receiver picture is evaluated for t
effects of this interference. A perfor
ance comparison is also made wi
operation of a black and white sign
under similar conditions. The te
are repeated with offset carrier oper
tions at a —28 db level.

Everyone in industry and Washin
ton is well aware of the thoroughne
of the work of these task groups, a
certainly their efforts will play
major role in producing better colo
casting and viewing.

GLOBAL TV, a doodling idea f
years, which last Spring captured t
fancy of Washington legislators a
prompted the evolution of a blu
print for a North Atlantic Treaty
plan, plus the introduction of a b
in the Senate to establish a Comm
sion on Cooperative International R
lations, which would encourage exi
ing agencies . . . "to design . . . a

(*Continued on page* 111)

# LUMPED-CONSTANT DELAY LINES

By
**C. L. FRUCHTER**
Tel-Instrument Co. Inc.

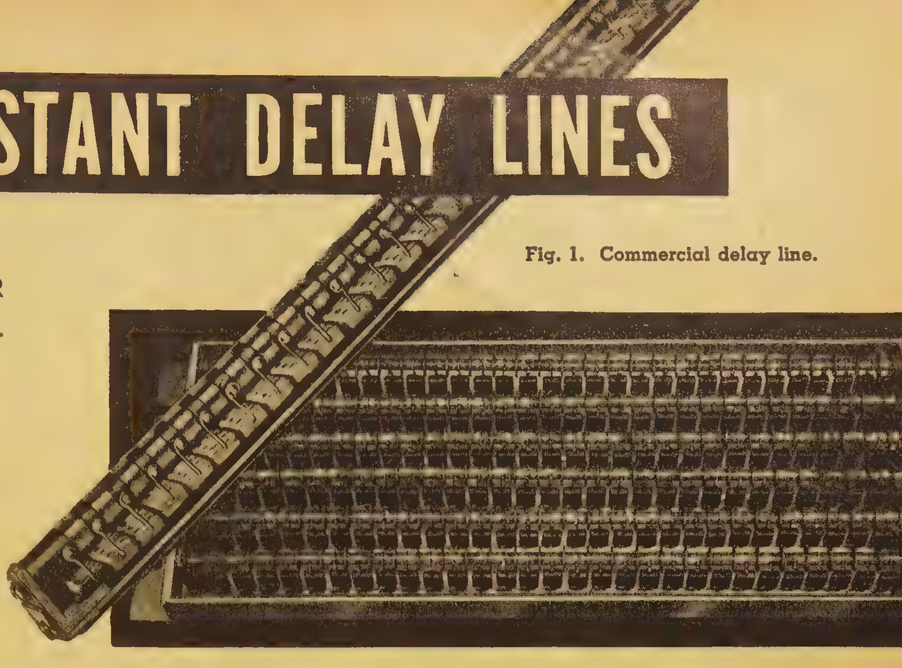


Fig. 1. Commercial delay line.

Fig. 2. A 30-section delay line which forms part of a television synchronizing signal generator. Each section has a delay of 0.1$\mu$sec.

*Design of filters incorporating a specified amount of delay with desired frequency and phase response.*

OR many years, design engineers have been confronted with the problem of storing or delaying in-rmation for short intervals of time. here the magnitude of the delay is of e order of microseconds, an electrical etwork in the form of a low pass filter sually represents the simplest and ost economical means of attaining the elay. The mathematical computations quired in the design of such filters, ith specified characteristics such as tal delay, impedance, or rise time, are sily accomplished; however, choosing e proper approach and design con-ants is often difficult.

There is a fair amount of literature n this subject scattered throughout the chnical books and periodicals of the ast twenty years. An engineer who udies this literature may well become nfused since not only does the termi-ology differ from paper to paper but ptimum design constants chosen by the any authors vary considerably.

The characteristic impedance of a de-y line is defined as:

$$_0 = \sqrt{L_0/C_0} \quad . \; . \; . \; . \; . \; . \; . \; . \quad (1)$$

nd the cutoff—or resonant—frequen-y, in cycles, is:

$$= 1/\pi \sqrt{L_0 C_0} \quad . \; . \; . \; . \; . \; . \; . \quad (2)$$

igure 5 represents two midsections of delay line, using a $\pi$ configuration, nd the corresponding end sections. The umber of midsections in a delay line f this kind determines the total delay. here is assumed to be no coupling be-ween the coils $L_0$. The series induct-nce of a single section of this line and e shunt capacitance of each section an be obtained from Eqts. (1) and 2), and are:

$$_0 = Z_0/\pi f_c \quad . \; . \; . \; . \; . \; . \; . \; . \quad (3)$$

$$_0 = 1/\pi f_c Z_0 \quad . \; . \; . \; . \; . \; . \; . \quad (4)$$

This type of line is called a constant filter and has the property that the amplitude-frequency characteristic of the impressed wave is independent of frequency between the frequency limits of 0 and $f_c$ when the line is terminated in its characteristic impedance. The delay per section, $\tau_s$, of the line is equal to $2/\omega_c$ when $\omega$ is very much smaller than $\omega_c$. This requirement, however, severely limits the usefulness of this network since the delay per section is inversely proportional to the cutoff frequency. Relatively long delays, of the order of 5 or 10 microseconds, and a high cutoff frequency, of the order of several megacycles, are often impractical requirements with a constant $k$ line. As a further design restriction, it should also be noted that the lower the characteristic impedance, the smaller the inductance $L_0$ becomes, and therefore the smaller the physical size and attenuation of each section. Over a limited range, the value of $C_0$ has a very small effect on either of these two parameters.

The design procedure is fairly simple. Usually the total delay is known as well as the line's application, and sometimes the characteristic impedance is specified. Where good reproduction of pulses is required, as high a value of $f_c$ should be chosen as is possible within the physical limitation of size, since the higher the $f_c$ value, the greater the number of sections for a particular delay. Each coil should be spaced from its neighbors by at least one coil diameter to minimize the coupling. If $Z_0$ is not specified, a value should be chosen which is as low as possible (usually in the range of 50 to 2000 ohms) and $L_0$ and $C_0$ computed. The delay per section can be calculated and is:

$$\tau_s = \sqrt{L_0 C_0} \quad . \; . \; . \; . \; . \; . \; . \; . \quad (5)$$

The number of sections required is then:

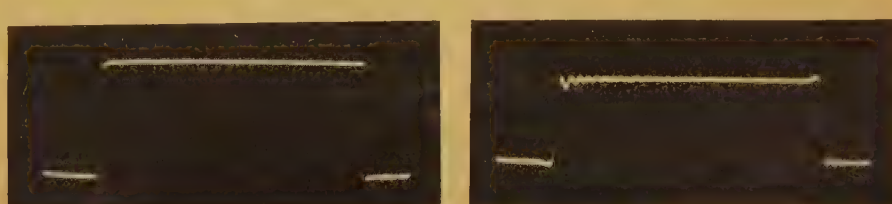
$$n = \tau/\tau_s \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (6)$$

A line composed of many sections should have its cutoff frequency increased[1] by a factor of $n^{1/3}$ to reduce the total distortion. With this new value of $f_c$, which will be called $f'_c$, the values of $L_0$, $C_0$, $\tau_s$ and $n$ should be recalculated. The value of $f'_c$ should then be divided by $n^{1/3}$ and a value close to the original $f_c$ obtained.

The line shown in Fig. 5 does not include any matching device to either the termination or the source, and often none is needed. The capacitor $C_0/2$, however, does make it easier to add

Fig. 3. Square wave "pre-shoot."

Fig. 4. A 100-kc. square wave before (left) and after (right) being delayed.



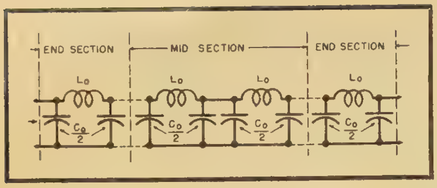


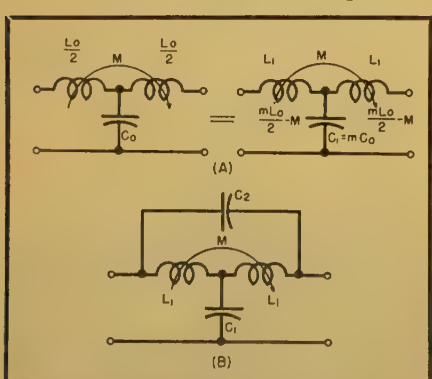

**Fig. 5. Two midsections and corresponding end sections of a delay line.**

lines in series than would be the case if the line were ended in an $L_0/2$ section or a matching section. Where a matching network is required, any of the conventional methods can be used, e.g., a half-section.

One of the properties quite often needed in a delay line is a constant delay over a wide frequency range. This property therefore requires that the phase rotation through the line must be exactly proportional to frequency since the slope of the phase angle vs. frequency curve is the transmission time delay. There remain two other forms of distortion which are important —amplitude and phase intercept distortion. The phase intercept distortion vanishes when the phase angle curve approaches and intercepts the zero frequency ordinate at an angle of 0° or any whole multiple of $\pi$ radians. This form of delay distortion is found at frequencies very much lower than $f_c$. Batchelder, in his patent,[2] uses a physical conductance across the shunt capacitor to reduce this distortion, which in general is not very serious. Some amount of amplitude distortion is present in all lines, and not too much can be done to avoid it. However, it can be greatly reduced by carefully controlling the allowable tolerances on the inductance and capacitance of the individual elements. Making the capacitance controllable, by the use of trimmer capacitors which can be adjusted for the best over-all response, is one means of compensating for element variations.

The next step from the constant $k$ line, which exhibits a large variation in delay with frequency, is the $m$-derived line as indicated in Fig. 7A. Here

**Fig. 7. (A) An m-derived delay line with mutual coupling between coils. (B) An all-pass bridged T delay line.**




the two coils are so placed physically that there is an inductive coupling between them, with the values of $L_0$ and $C_0$ modified by a factor $m$ to retain the same cutoff frequency and characteristic impedance as exist in the constant $k$ line. The same relationships exist as indicated in Eqts. (1) through (4) as well as those relating $L_0$, $M$, the coefficient of coupling $K$ and the modifying factor $m$.

$$M = \frac{1 - m^2}{4m} L_0 \quad \ldots\ldots\ldots \quad (7)$$

$$L_1 = \frac{m\, L_0}{2} - M = \frac{m^2 + 1}{4\, m} L_0. \quad \ldots \quad (8)$$

$$K = \frac{M}{L_1} = \frac{m^2 - 1}{m^2 + 1} \quad \ldots\ldots\ldots \quad (9)$$

$$C_1 = m\, C_0 \quad \ldots\ldots\ldots \quad (10)$$

The delay per section, $\tau_s$, is:

$$\tau_s = \frac{m}{\pi\, f_c} \quad \ldots\ldots\ldots \quad (11)$$

If $n$ is the number of sections, then the total delay is $n\tau_s$, and if $f_c$ is increased by a factor of $n^{1/3}$, an expression

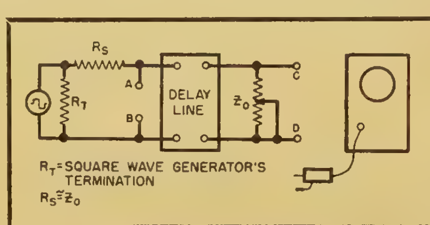



**Fig. 6. Method for measuring the delay and characteristic impedance of a line.**

for $n$ in terms of the total delay can be derived:

$$n = \left[\frac{\pi\, f_c}{m}\, \tau\right]^{3/2} \quad \ldots\ldots\ldots \quad (12)$$

This method, however, sometimes requires entirely too many sections, and so an approximation is used as illustrated in the typical problem presented later. This approximation is usually more than adequate.

The angle of the phase shift through one $T$ section is:

$$\beta = 2 \sin^{-1} \frac{m\, \omega/\omega_c}{\sqrt{1 - (\omega/\omega_c)^2\, (1 - m^2)}}$$

$$= T\, \omega \text{ radians} \quad \ldots\ldots\ldots \quad (13)$$

and the slope at any point of the curve of this phase angle vs. the ratio $\omega/\omega_c$ is the time delay, $T\, \omega_c$ seconds, for each section, between the limits of $f = f_c$ and $f = 0$, and is expressed by:

$$\frac{d\, \beta}{d\, (\omega/\omega_c)} = \frac{2\, m}{\sqrt{1 - \left(\frac{\omega}{\omega_c}\right)^2} \left[1 - \left(\frac{\omega}{\omega_c}\right)^2 \left(1 - m^2\right)\right]}$$

$$= T\omega_c \text{ seconds} \quad \ldots\ldots\ldots \quad (14)$$

A form of line which exhibits a more constant impedance between the limits of $f = f_c$ and $f = 0$ is the all-pass bridged $T$ line ($BT$). Here all the parameters are identical with the $T$ except for the bridging capacitor $C_2$ which is

across both coils $L_1$, as indicated [in] Fig. 7B.

The phase shift of one section of t[he] $BT$ is:

$$\beta = 2 \tan^{-1} \frac{m\, \omega/\omega_c}{1 - (\omega/\omega_c)^2} = T\omega \text{ radians} \quad \ldots\ldots\ldots \quad (15)$$

and the delay is:

$$\frac{d\, \beta}{d(\omega/\omega_c)} = \frac{2m\left[1 + \left(\frac{\omega}{\omega_c}\right)^2\right]}{\left[1 - \left(\frac{\omega}{\omega_c}\right)^2\right]^2 + m^2 \left(\frac{\omega}{\omega_c}\right)^2}$$

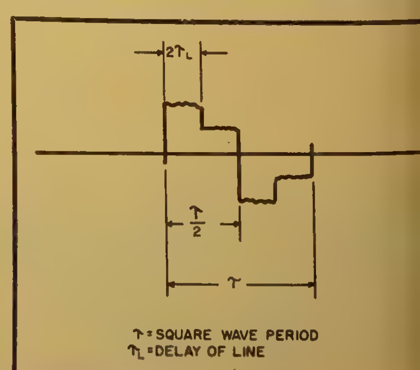
$$= T\omega_c \text{ seconds} \quad \ldots\ldots\ldots \quad (16)$$

Figure 10 is a plot of the delay v[s.] $\omega/\omega_c$ (Eqts. (14) and (16)) for some [of] the more commonly used values of [m.] The notation is that as given in Tur[n]er[3]. Note that the curves for the $T$ se[c]tions pivot about the points where $\omega/$[$\omega_c$] $= 0.6$ and $T\omega_c = 3.3$, and that t[he] curves which are symmetrically locat[ed] relative to these points are very near[ly] complementary, so that by the prop[er] choice of $m$ the delay distortion of t[he] $T$ can be approximately compensat[ed] by a $BT$ line. As indicated on th[e] graph, Turner chose an $m = 1.49$ valu[e] since this value allows all the coils to [be] identical.

A series of experiments was co[n]ducted to determine the effect of t[he] value of $m$ on the response of a line to [a] square wave with a fast rise time, [at] fundamental frequencies up to 1 m[c.] The cutoff frequencies of the indivi[d]ual sections of the many lines test[ed] were between 7 and 12 mc., and the d[e]lay per section varied between .01 a[nd] .05 μsec.; the total delay of all the lin[es] varied between 0.25 and 0.8 μsec., t[he] characteristic impedance of the lin[es] varied between 75 and 500 ohms, a[nd] the value of $m$ varied between 1.11 a[nd] 1.52. The test procedure is given in t[he] following paragraph.

A properly terminated square wa[ve] generator was connected to the li[ne] under test through a series resistan[ce] approximately equal to the characte[r]istic impedance of the line, and t[he] line was terminated in a pure resis[t]ance. Both the terminating resistor a[nd] the series resistor were carefully a[...]

**Fig. 8. Waveform on scope whe[n] using the technique indicated in Fig. 6**



sted to minimize reflections at the ds of the line. The probe of a wide-nd oscilloscope was connected across e last shunt capacitor and all of the unt capacitors had trimmers across em which were adjusted for the best er-all response. In the case of the $T$ lines, capacitor $C_2$ is a trimmer nich was also adjusted for the best er-all response.

Results of these tests indicated that e best reproduction of the input uare wave could be obtained with a $T$ line of $m = 1.50$, and that in most ses the higher the value of $m$, the tter the response. The bridging ca-citor was approximately equal to 0.12 ; however, an interesting phenome-n observed with almost all of these nes was a "pre-shoot" which occurred the end of the square wave, as shown Fig. 3. In some cases, the amplitude the "pre-shoot" was sufficient to ake the line unsatisfactory. It was und that this "pre-shoot," with regard the $BT$ line, either did not exist at all was of extremely small amplitude. urther investigation showed that idging small capacitors across indi-dual sections of a $T$ line reduced the nplitude of the "pre-shoot" until it as negligible. These capacitors have ly a very slight effect on the line's se time, frequency response, or delay.

Kallmann[4] has recommended an $m$ 1.27 value, and this value has found uch use in recent designs. It will gen-rally give good results and is recom-ended at least as a starting point. he value of $f_c$ must be determined by ther the end use of the line or from a nowledge of the type of signal to be ent through it. Moskowitz and Racker[5] dicate a rule of thumb for calculating e maximum frequency of a pulse as qual to $1/2t_r$ where $t_r$ is the rise time. hey suggest that the $f_c$ of each section of the line be set at 1.22 to 2 times this value. Again the characteristic impedance should be chosen consistent with the circuit requirements and as low as possible.

An $m$ of 1.27 gives constant delay out to 0.6 $f_c$. An $m$ of 1.40, as suggested by Lester,[6] shows a considerable variation in delay (see Fig. 10). Turner's combination of $T$ and $BT$ sections shows a fairly constant delay to about 0.85 $f_c$; however, it does have the disadvantage of requiring another element. When the use of a $BT$ line is contemplated, it should be remembered that the response of this type of line is still quite good at $f_c$ where the delay distortion is considerable. As this distortion can be serious in many cases, the highest frequency component of the input signal should be well below $f_c$.

To illustrate the use of the foregoing equations, consider the design procedure for a $T$ line of $m = 1.27$. Let the total delay be 1 $\mu$sec., the highest frequency component 10 mc., and the characteristic impedance 200 ohms. Since the delay is constant to 0.6 $f_c$, $f_c$ should be $10/0.6 = 16.67$ mc. The delay per section from Eqt. (11) is 0.0243 $\mu$sec. and the number of sections from Eqt. (6) is 41. To obtain the same fidelity from the entire line as would be obtained from a single section, $f_c$ should be increased by $n^{1/3}$, giving a new value for $n$ of 140 sections.

The various constants of the line may be calculated as follows:

$$L_0 = \frac{Z_0}{\pi \; f'_c} = 1.11 \; \mu\text{hy}.$$

$$C_0 = \frac{1}{\pi \; f'_c \; Z_0} = 27.8 \; \mu\mu\text{fd}.$$

$$L_1 = \frac{m^2 + 1}{4m} L_0 = 0.572 \; \mu\text{hy}.$$

$$C_1 = m \; C_0 = 35.3 \; \mu\mu\text{fd}.$$

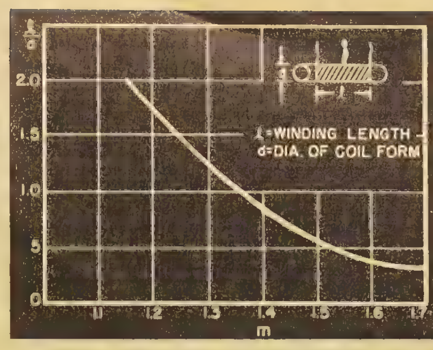



Fig. 9. Winding factor (length divided by diameter) for m-derived filter.

$$M = \frac{1 - m^2}{4m} L_0 = -0.133 \; \mu\text{hy}.$$

$$L_T \text{ (total inductance)} = 2L_1 - (-2M) = 1.41 \; \mu\text{hy}.$$

One of the most convenient methods of obtaining the correct total inductance $L_T$ is to wind both coils as a single layer solenoid of the proper winding length-to-form-diameter ratio $(l/d)$. Figure 9 is a plot of the ratio of the winding length to the diameter of the coil vs. $m$. A form diameter is chosen, and the number of turns $N$ is determined by:

$$N = \sqrt{\frac{85.8 \, L_T}{d}} \quad . \; . \; . \; . \; . \; . \; . \quad (17)$$

where $d$ is the form diameter in inches, and $L_T$ the total inductance of a single section in microhenries. The ratio $l/d$ is found from Fig. 9 and the winding length calculated. By means of a wire table, the wire size that will give $N$ turns in a length $l$ is determined. The coil must be tapped at $N/2$; this can be done by winding half the coil, stopping the winding machine, forming a loop and twisting it tightly, and then continuing with the winding. Some care must be exercised in choosing a wire size. Wire smaller than #38 is some-

(*Continued on page 26*)

Fig. 10. Delay curves of T and bridged T lines.

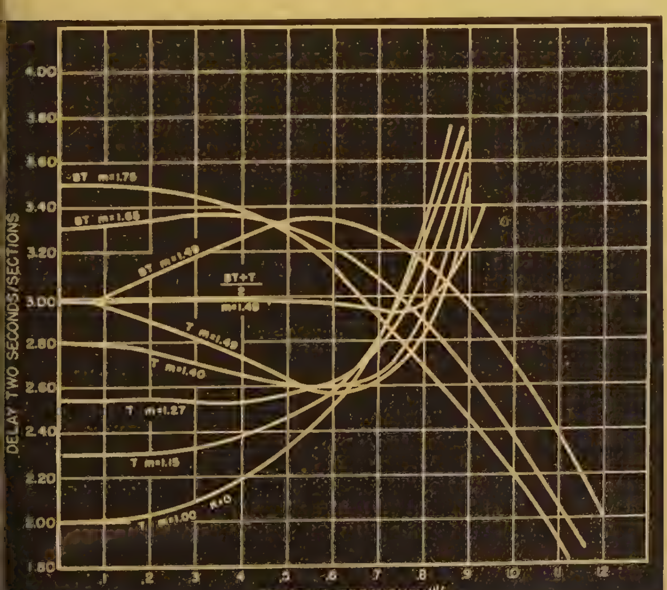
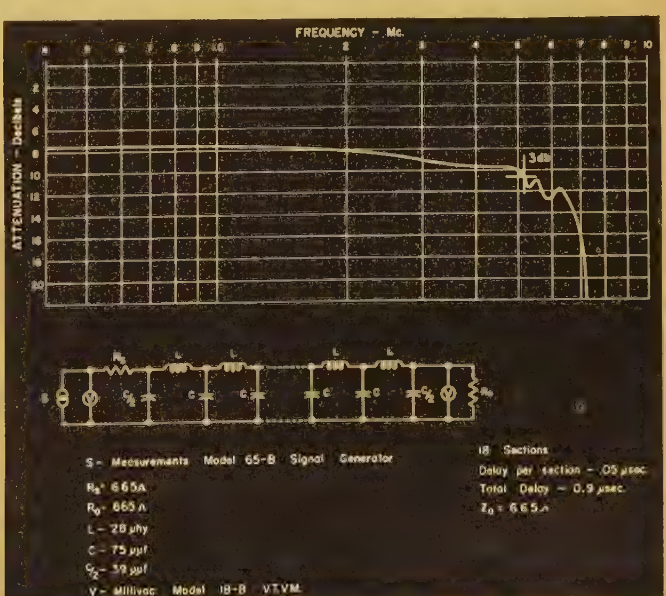



Fig. 11. Frequency response of line shown in Fig. 1.



# PRESSURE TESTING OF TV TUBES

By **G. D. OSTRANDER**

Sylvania Electric Products Inc.

*The strength of metal or glass TV picture tubes may be checked by means of air or water pressure.*

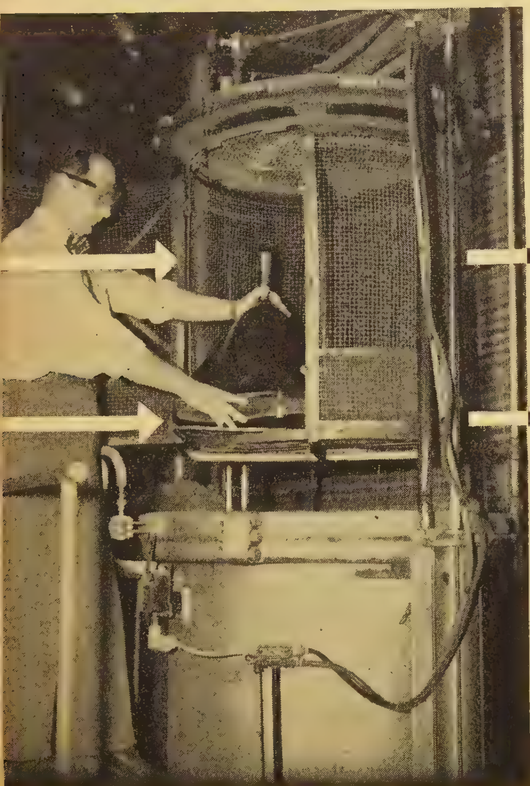


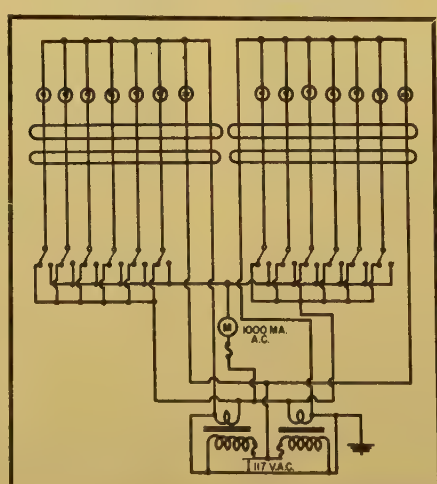
**Fig. 1. Tube is placed in cage before being lowered into water pressure tank.**

PREVIOUSLY published articles have pointed out many of the important factors which must be considered in the production of television picture tubes. Pictures and articles have been published concerning the importance of thorough testing and the many precautions necessary in manufacturing screens. Maintaining control of the critical spacings in the electron gun has been emphasized as well as the absolute necessity of insuring leakproof seals in the base. All these precautions, however, are of no avail if the bulb is not of the same high quality and built with the same care.

Much research in this basic field has been done by the bulb manufacturers. A well-designed bulb is also important from the standpoint of safety in handling, both during production and during installation. Since the tubes are rigidly inspected for physical flaws and imperfections, it is also advantageous to have the best bulb possible to reduce the number of rejects during the manufacturing process. These factors become increasingly more important as the size of the bulb is increased.

The present trend toward larger television picture tubes of the highest possible quality makes it necessary to obtain more and more information as to the strength and behavior of both glass and metal bulbs under the stresses created by the high vacuum in the tubes. Faced with the need for information, methods have been devised to test such tubes mechanically under pressures greater than one atmosphere (approximately 15 psi). Such methods may use either air or liquid (water) pressure systems. Both systems are used by *Sylvania's* Television Pictu Tube Division.

**Fig. 2. Circuit for implosion monitoring tubes in air pressure tank.**




## Liquid Pressure System

In using the liquid system, a tube enclosed in a screen cage (see Fig. and is lowered into a tank which filled with water at a known temper ture. The tank is then sealed off and controlled cushion of air is allowed enter the tank to build up the pre sure to any desired value. Due to t incompressibility of water, the pre sure is transmitted equally over t whole surface of the tube, and the pre sure is built up until the tube is brok at some indicated gage pressure. tube to be tested in this manner m be first abraded (or scratched), usi 150 emery grit, around the four sid and corners of the faceplate to simula any desired degree of abrasion whi might be encountered in handling. T water tank setup is quite flexible, quires a minimum of space, and enabl rapid testing at a moment's notice.

Occasionally it may be desirable pressure-check bulbs before they a made into tubes and exhausted. This done simply by inserting a rubber sto per in the flared end of the neck a subjecting the bulb to pressure as b fore. The applied pressure in this ca (since the bulb contains air at atmo pheric pressure and not a vacuum) w be read directly as gage pressu whereas tubes already exhausted a actually under a pressure of 15 psi d to the vacuum, plus the indicated ga pressure. To eliminate any confusi which might exist when referring the test results, all pressures are corded as absolute readings and refer actual pressures exerted upon the tu or bulb body—whether the tube is und a vacuum or stoppered to air.

This liquid system is very useful obtaining data quickly to detect a flaws in bulb construction or defects d to scratches, chips or imperfections glass quality. Much useful informat may be obtained from the remains the tube by examining the fractu patterns of the glass chips.

## Air Pressure System

It may also be of interest to subj bulbs to pressure for longer periods time to determine glass or metal tigue effects occurring over a period days. Any such setup which must continuously, 24 hours a day for a w or so, must be carefully controlled to pressure. A means must also be vised to monitor the tubes under and indicate their condition. Such testing system has been set up an now being used by *Sylvania's* Televis Picture Tube Division General En neering Department at Seneca Falls

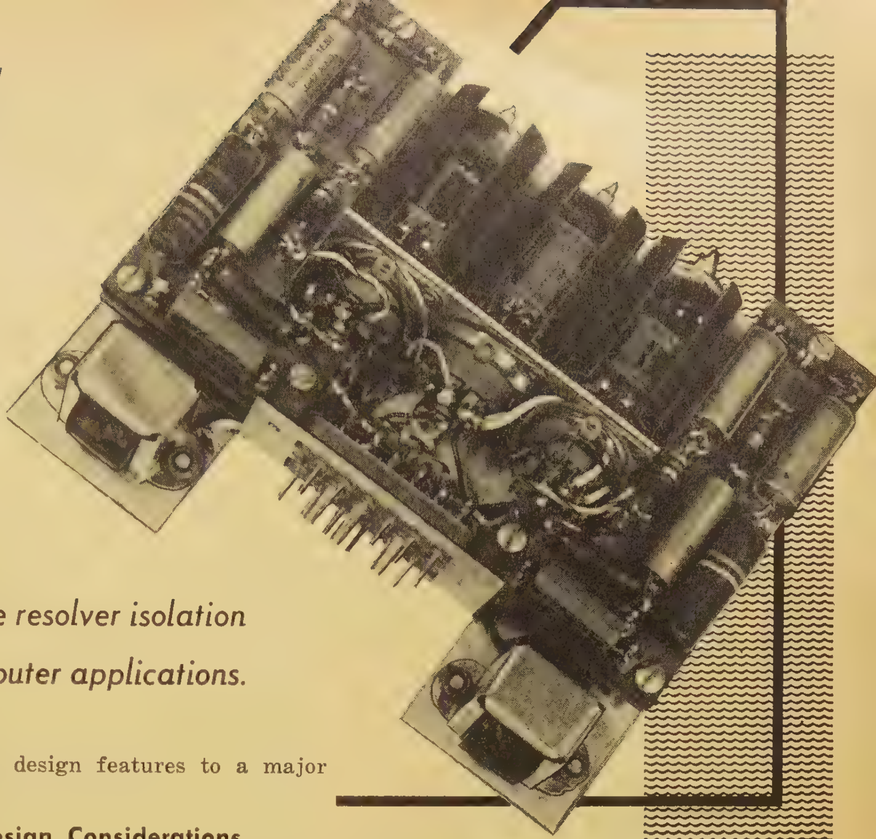
Consistent and reliable data car

(*Continued on page* 25)

# IGH-STABILITY ISOLATION AMPLIFIER*

By **ROBERT C. MOSES**

Lear, Incorporated



Oblique view of two-channel unit amplifier.

*Design and development of a stable resolver isolation amplifier for precision analog computer applications.*

HE resolver isolation amplifier to be lescribed here was developed for use vith appropriate angle resolvers in airborne analog computer application ere a high degree of accuracy and bility is required. Since the most se- us errors in such a computer are ributable to high resolver driving- rce impedance and/or to resolver ondary loading, it is the fundamental pose of the isolation amplifier to vide a low driving source impedance the driven resolver together with a h and constant load impedance to the ving resolver.

Because as many as twelve resolver plifiers may be involved in a com- er system, a high order of stability amplifier transfer characteristics h variations in tube parameters, mary supply voltages, and environ- ntal conditions is necessary if the uired accuracy is to be obtained. is furthermore very desirable that inherent stability of the amplifier substantially better than that of the olver, so that any variations in the plifier itself will not impair the over- accuracy of the system.

Major electrical specifications of the ation amplifier as dictated by the re- rements of the over-all system are en in Table 1.

Because a relatively large number of ation amplifiers is required in the tem, and the space available in the tronic package is very limited, the ve specifications must be met with inimum number of tubes and com- ents. This factor, together with cer- n environmental requirements pecul- to airborne equipment, has dictated the basic design features to a major extent.

*s article is based on a paper presented at Airborne Electronics Conference, Dayton, , May 11-13, 1953.*

### Basic Design Considerations

Analysis of the foregoing specifications with respect to amplifier gain, gain stability, and terminal impedances indicates that a negative feedback amplifier with a feedback factor of very nearly unity is required. In such an amplifier, the gain stability as a function of variations in internal or loop gain due to changes in supply voltages, tube characteristics, and component values, etc., is related to the nominal loop gain according to the relation given in Eqt. (1):

$$\%\ A_F \text{ variation} = \left[\left[\frac{A\,(1-c)}{A_F + (1-c)\,(A - A_F)}\right] - 1\right] \times 100 \qquad (1)$$

where $A$ = gain without feedback
$A_F$ = gain with feedback = 1.002 nominal
$c$ = fractional variation in $A$ expressed as a decimal

This expression was derived from the gain equations for a feedback amplifier by obtaining the derivative of $A_F$ with respect to $A$, $c$ representing fractional changes in the latter; Eqt. (1) is strictly valid only for values of $A_F$ close to unity. The curves of Fig. 1 show % variation in gain with feedback plotted against gain without feedback for several values of $c$.

**Table 1. Major electrical specifications.**

*Gain:* adjustable from 1.000 to 1.060

*Gain stability:* ± .03% nominal, ± .05% minimum for all possible operating conditions

*Phase shift:* 0.0° ± 5′

*Signal characteristics:* input voltage, 0-40 volts r.m.s.; frequency, 900 ± 10% cps

*Distortion:* 0.5% maximum total harmonics

*Impedance characteristics:*
load—4950 ohms at 73°;
input—>500,000 ohms;
output—<15 ohms

It was anticipated that the combined effects of all factors which might affect the loop gain, i.e., component tolerances, tube aging, supply voltage variations, and changes due to environmental conditions, would not cause a variation of more than 50% in the latter; hence a value for $c$ of 0.5 is considered a reasonable maximum. Specified gain stability requirements of .02% to .05% leads to a preliminary design center value of 3800X for loop voltage gain. In the interests of circuit simplification, a design utilizing a triode resistance coupled to a pentode, with cathode feedback to the former, was selected. Impedance and gain considerations dictate the use of a cathode follower for coupling to the driven resolver; this has the twofold advantage of presenting a large effective load impedance to the pentode gain stage as well as a low source impedance for both the resolver and the over-all feedback loop.

A block diagram of the three-stage amplifier is shown in Fig. 2. Input and output terminals are indicated, as is the

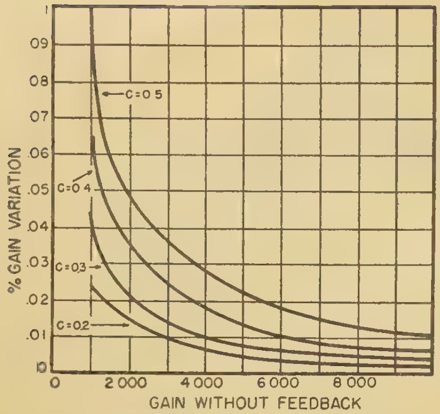



**Fig. 1. Per-cent gain variation with feedback vs. gain without feedback.**

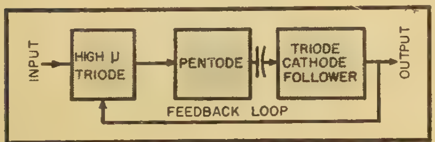



**Fig. 2. Block diagram of amplifier.**

feedback loop which is d.c.-coupled to the cathode of the triode input stage. The two vertical lines between the second and third blocks do not designate a capacitor in this case, but indicate the point at which the loop is broken for purposes of the following analysis.

In a stage-by-stage analysis of a design incorporating substantially 100% over-all feedback, it is generally necessary to treat each stage as an element of an open-loop system, in order to determine its individual transfer characteristics. The point at which the feedback chain is opened must be so selected that any impedances common to two or more stages remain essentially unmodified; this usually necessitates opening the loop at an appropriate point in the forward signal path. In this discussion, the feedback chain is assumed to be broken between the pentode plate and the cathode follower grid, with the latter taken as the input terminal of a three-terminal network. Gain expressions for the cathode follower, triode, and pentode stages are given in Fig. 4.

In Eqt. (1) of Fig. 4, $R_k$ represents the impedance of the tuned resolver load, which for the particular resolver used is of the order of $7000 + j0$ ohms. The effective $Q$ of the tuned resolver is slightly greater than 0.2, when damped by the equivalent output impedance of the cathode follower. The calculated voltage gain of this stage is 0.88X and the output impedance 167 ohms.

The triode gain stage is subject to cathode degeneration by virtue of the feedback connection, which accounts for the appearance of the term $R_k\ (1 + \mu)$ in the denominator of Eqt. (3), Fig. 4. $R_k$ in this case represents the output impedance of the cathode follower plus any series impedances in the feedback loop, whereas $R_L$, $R_p$, and $R_g$ are the plate load, tube plate resistance, and following stage grid resistor, respectively. Maximizing Eqt. (3) for gain, it will be seen that $\mu$ should be as large as possible while $R_k$ should be kept small. At the same time, it can be shown that where a feedback loop is returned to the cathode of the first stage, the sensitivity in over-all gain with feedback to variations in $\mu$ of the first tube cannot be made appreciably less than $1/\mu$. Therefore, the amplification factor of the first tube should be large, both from the standpoint of maximum loop gain and best over-all gain stability.

The voltage gain of a pentode amplifier at medium frequencies may be expressed by Eqt. (4) of Fig. 4. Because both $R_p$ and the effective input resistance $R_g$ of the following stage are large compared with the plate load $R_L$, a voltage gain approaching 200X may readily be obtained in a pentode of the 6AK5 class, with a plate resistor of 120*K* ohms. The over-all gain of the system is, of course, the product of the voltage gains of the individual stages, and under open-loop conditions measures 4170X from the grid of the cathode follower to the plate of the pentode gain stage.

## Circuit Features

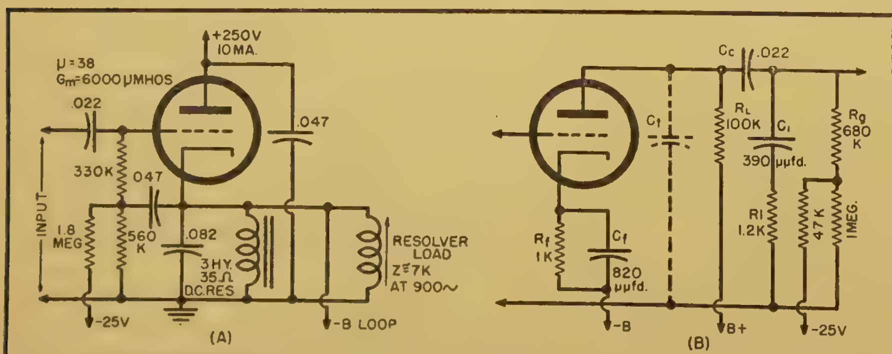
Turning now to the design features of the individual stages, Fig. 3A shows the cathode follower and its associat[ed] resolver load. This stage has a numb[er] of features of interest. The output cat[h]ode follower tube must be capable [of] passing a quiescent d.c. plate curre[nt] somewhat greater than the peak d[y]namic current represented by the re[quired] peak output voltage divided [by] the load impedance. When working in[to] a predominantly inductive load, neg[a]tive peak clipping sets in appreciab[ly] before the instantaneous plate curre[nt] reaches zero, due to an elliptical lo[ad] line; thus the quiescent plate curre[nt] may need to be even higher than t[he] above calculations indicate. This cond[i]tion may be compensated to some exte[nt] by resonant tuning of the inductive lo[ad] circuit, in which case the latter [is] treated as a substantially pure r[e]sistance. Nevertheless, for large outp[ut] voltages, the choice of a tube type f[or] the cathode follower stage is govern[ed] primarily by plate dissipation co[n]siderations. A tube having a plate di[s]sipation rating of 2.7 watts and cha[r]acteristics similar to one section of type 12AV7 is well-suited to the a[p]plication; using the triode section of type 6U8 triode-pentode, it is possib[le] to develop up to 55 volts r.m.s. acro[ss] the load before negative peak distorti[on] becomes apparent. This is well abo[ve] the specified value of 40 volts.

Because undesirable reaction torq[ue] effects occur when appreciable d.c. [is] passed through the resolver stat[or] winding, means must be provided f[or] maintaining the residual current bel[ow] 2.0 ma. The cathode circuit of the o[ut]put tube is returned to ground throu[gh] a choke having a d.c. resistance o[ne] tenth or less that of the resolver stat[or] winding and an inductance of about t[wo] to three times the latter. The resolv[er] and choke inductances are lumped t[o]gether and treated as the effective i[n]ductance of the tuned load circuit.

A fixed grid bias of -5.5 volts is su[p]plied to the cathode follower tu[be] through a voltage divider from the -[25] volt supply. Because of possible gas cu[r]rent difficulties in a triode operati[ng] at a sustained high plate dissipati[on] the d.c. resistance in the grid circ[uit] is kept relatively small. To reduce pl[ate] circuit loading on the preceding sta[ge] a form of capacitive feedback fr[om] cathode-to-grid return is incorporat[ed] whereby the apparent input resista[nce] of the cathode follower is as much [as] nine times the value of the grid [re]sistor. This provides a 10-15% incre[ase] in effective gain of the pentode sta[ge.] The measured voltage gain of the ca[th]ode follower at 900 cycles—wh[en] working into a tuned resolver load—[is] 0.88X, and the open-loop output imp[ed]ance is 190 ohms.

The triode input stage is subject [to] cathode degeneration by virtue of [the]

**Fig. 3. (A) Schematic diagram of cathode follower and associated load. (B) Phase-compensating elements $R_1$ and $C_1$ inserted in the triode stage.**



dances associated with the feed- loop. Hence, the cathode follower ıt impedance, the equivalent im- nce of the resolver load, and any s impedances in the feedback loop be taken into account in calcula- of the transfer characteristics of tage. The cathode follower output dance is very much smaller than dynamic impedance of the tuned circuit in parallel with it; hence at ıance the latter can be neglected. effective impedance in the cathode it of the triode is, to a close oximation, the cathode follower ıt impedance in series with the back resistor, and it is substantially tive.

e values of triode stage plate load tor, coupling capacitor, and follow- stage grid resistor were selected he basis of conventional resistance- led amplifier practice. Preliminary e of feedback resistor was based c. bias requirements. The tube used ne section of a type 12AX7 having ted $\mu$ of 100 and rated $R_p$ of 62,500 s. Calculated voltage gain was 28X a 100$K$ plate load, while the meas- gain is 25X.

esign of the pentode stage is ghtforward in that selection of ponent values was made on the s of maximum stage gain consistent phase requirements. The tube used is the equivalent of the 6AK5 ode, having a rated $G_m$ of 5100 os and approximate $R_p$ of 0.5 meg- . By reference to the characteristics his type, it was determined that imum gain in resistance-coupled ications could be obtained when $E_b$ $3E_{bb}$; and having selected a suit- value of plate load resistance, the rol grid and screen potentials were l accordingly. To eliminate the need a large electrolytic capacitor for ode bypassing, the cathode is nded, and a fixed bias of —1.2 s is applied to the grid through a der across the —25 volt supply.

resistance - coupled applications re the load resistor is relatively e, the published tube $G_m$ and $R_p$ values do not give a true representation of the stage gain to be expected. The effective $G_m$ generally ranges from 0.3 to 0.4 of the rated value, while the rated $R_p$ is multiplied by roughly the reciprocal of this factor. Applying these corrections, the calculated voltage gain of the pentode stage was 205X and the measured gain is 190X.

Use of multisection tubes in the over-all design permits assembly of a two-channel isolation amplifier with but three tube envelopes, a decided saving in space. Each channel utilizes one-half of a 12AX7 dual high-mu triode for the input stage, followed by a 6U8 pentode section, coupled in turn to the 6U8 triode section as the output cathode follower. Gain control is accomplished by means of a high resistance potentiometer in the cathode circuit of the triode stage for each channel; this control shunts the feedback loop, allowing variation of the gain with feedback from 1.001 to 1.060. Gain and phase shift measurements were conducted on each channel of the complete amplifier by opening the feedback loop between the pentode and cathode follower stages, applying the input signal to the grid of the latter, and measuring the output at the pentode plate. The input triode grid was grounded during these tests. A curve showing over-all amplitude and phase characteristics as a function of frequency is shown in Fig. 5A. It should be noted that no phase compensation has been incorporated into the design at this point.

## The Stability Problem

Stability against oscillation in a feedback amplifier requires that the gain within the feedback loop be less than unity at frequencies where the total phase shift around the loop becomes 180°—the Nyquist criterion. The difficulty in realizing this condition depends both upon the loop gain and upon the total number of phase shifts within the loop, since the maximum phase shift in any one network cannot ordinarily exceed 90°. The procedure generally adopted in stabilizing a closed-loop system revolves around controlling the transmission characteristics around the loop at frequencies where phase shifts become important, in this case the region above about 200 kc. The curves of Fig. 5A show that, with a total voltage amplification at medium frequencies exceeding 72 db, the loop gain is appreciably greater than unity at 245 kc. where the loop phase shifts total 180°. High frequency oscillation was accordingly experienced, and appropriate phase compensation became necessary.

The major sources of high frequency phase shift are the shunting capacitances associated with the two interstage coupling networks and the characteristics of the resonant resolver load. The latter contributes virtually a 90° phase lag above about 85 kc., and cannot in itself be compensated. The interstage networks also contribute phase lags, each of which is asymptotic to 90° at frequencies of the order of 900 kc. In order to satisfy the criterion for stability with a loop gain of 72 db, it is necessary to achieve an attenuation slope approaching the critical 12 db per octave while still maintaining an adequate margin of safety. With a slope of

$A$ (cathode follower, $R_k = 7000$ ohms)

$$= \frac{\mu R_k}{R_p + R_k(\mu + 1)} = 0.88\times \quad (1)$$

$Z_0$ (Cathode follower)

$$= \frac{R_p}{\mu + 1} \cong \frac{1}{G_m} = 167 \text{ ohms} \quad (2)$$

$A$ (triode)

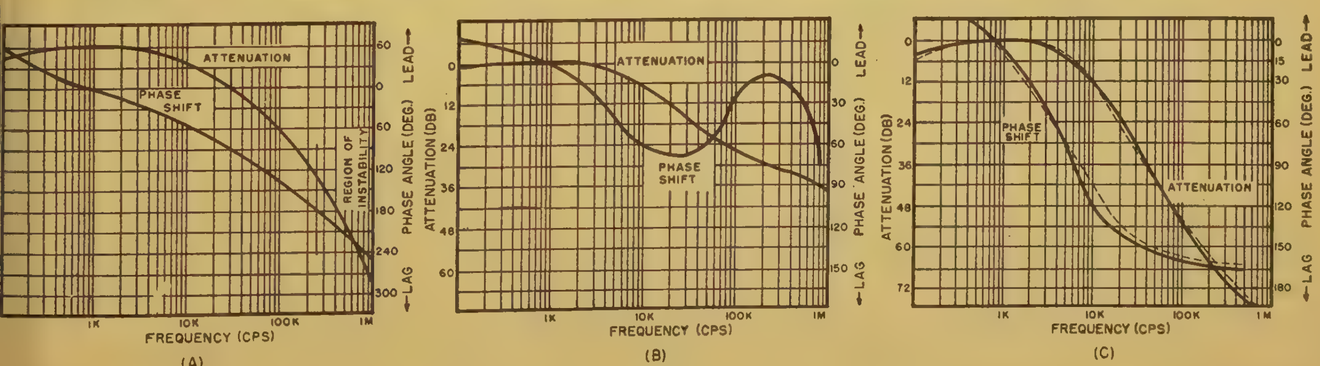
$$= \frac{\mu \left[\dfrac{R_L R_g}{R_L + R_g}\right]}{R_p + \left[\dfrac{R_L R_g}{R_L + R_g}\right] + R_k(\mu + 1)} = 25\times \quad (3)$$

$A$ (pentode)

$$= G_m \left[\frac{1}{\dfrac{1}{R_L} + \dfrac{1}{R_p} + \dfrac{1}{R_g}}\right] = 190\times \quad (4)$$

**Fig. 4. Gain expressions for cathode follower, pentode, and triode stages.**

**Fig. 5. (A) Over-all amplitude and phase characteristics with no phase compensation. (B) Attenuation and phase characteristics of first stage with phase compensation. (C) Attenuation and phase characteristics of the final amplifier.**



*Loop gain:* 4170X in voltage

*Phase margin:* 13°

*Input impedance:* 980,000 ohms

*Output impedance:* <0.2 ohms

*Phase shift at 900 cps:* <.08°

*Over-all gain:* 1.001 minimum; 1.060 maximum

*Gain stability with 50% change in loop gain:* .022% at gain 1.001X; .027% at gain 1.060X

*Maximum undistorted output voltage:* 55 volts, r.m.s.

*Total distortion at 40 volts, r.m.s.:* < .05%

*Linearity, 1-40 volt input:* ±.020% maximum deviation

*Interchannel crosstalk:* -58 db below full output

**Table 2. Major performance characteristics of each channel of a two-channel prototype isolation amplifier.**

10 db per octave, the rolloff must commence seven or more octaves below the critical frequency of 245 kc., or at approximately 1900 cps. To assure reasonable phase margin, a somewhat lower cutoff frequency is desirable. Accordingly, a capacitor is shunted across the equivalent parallel resistance of the first interstage, of such value as to produce a central or —3 db frequency of 5500 cps with an accompanying phase lag of 45°. A small resistor is placed in series with this capacitor in order to control the phase characteristics at frequencies above about 100 kc. This is shown in Fig. 3B. $C_1$ and $R_1$ are the phase-compensating elements, $R_0$ is the equivalent parallel resistance, and $C_t$ the shunt capacitances associated with the interstage. The value of $C_1$ is chosen to provide the required attenuation characteristics as mentioned above. The network $C_1 R_1$ itself possesses an inverse tangent phase characteristic defined by the expression:

$$\varphi_1 = -\tan^{-1}\frac{1}{\omega C_1 R_1} \quad . \ . \ . \ . \ . \ . \ . \quad (2)$$

while the interstage, $C_0 R_0$, has the normal tangent phase characteristic:

$$\varphi_2 = -\tan^{-1}\omega C_0 R_0 \quad . \ . \ . \ . \ . \ . \ . \quad (3)$$

where $C_0 = C_t + C_1$

$$R_0 = \frac{R_p R_1}{R_p + R_1}$$

The net phase shift is the sum of the two tangent curves defined above; it exhibits a reduced phase lag characteristic which tends to return to zero phase shift between certain limiting frequencies determined by the central frequencies of $R_0 C_0$ and $R_1 C_t$. At the same time, the attenuation characteristic is now determined by $C_1 + C_t$ rather than by $C_t$ alone, and it is asymptotic to 6 db per octave above the cutoff frequency of 5500 cps. When this is added to the normal attenuation produced by the second interstage and the resolver load circuits, the required attenuation slope of 10 db per octave will be obtained. The attenuation and phase characteristics for the first interstage with phase compensation are shown in Fig. 5B.

When the phase correction techniques described above were applied, the a[...] plifier was stable at a loop gain of 7[...] db (voltage gain ≅ 4200X), with [...] equivalent amount of active feedba[...] However, the calculated phase mar[...] was only of the order of 6°, which [...] considered inadequate for product[...] tolerances. Supplementary phase c[...] rection can be provided by introducin[...] leading phase shift in the cathode [...] cuit of the first stage. This is acc[...] plished by means of a small capaci[...] shunting the feedback resistor.

The effective output resistance $R_0$ [...] a triode with cathode degenerati[...] where the cathode impedance $R_k$ is n[...] reactive, may be expressed by:

$$R_0 = R_p + R_k\,(1 + \mu) \quad . \ . \ . \ . \ .$$

and is purely resistive, neglecting t[...] capacitances. If $R_k$ is incompletely [...] passed with a small capacitor, the s[...] ond term in Eqt. (4) becomes:

$$\frac{(1 + \mu) R_k}{R_k - \frac{j}{\omega C_k}} \quad . \ . \ . \ . \ . \ . \ . \ . \ . \quad (4$$

and $R_0$ becomes complex. The resulti[...] phase angle is:

$$\varphi_3 = \tan^{-1}\omega C_k R_k (1 + \mu) \times \left[\frac{R_k}{R_p + R_k(1 + \mu) + R_L}\right] \quad . \ . \ . \ .$$

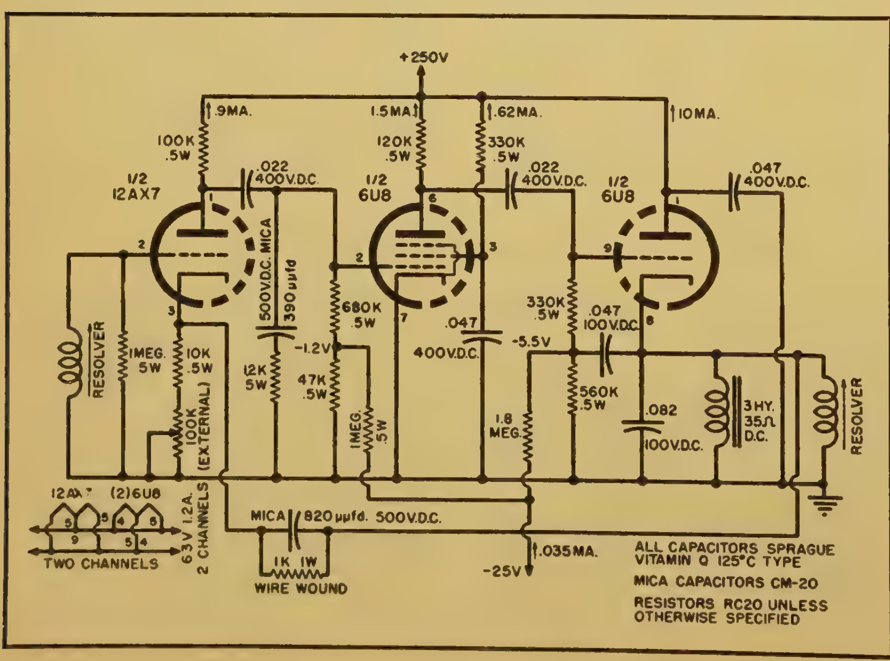
and constitutes a high-frequency le[...] ing phase angle in the a.c. cathode c[...] rent. The net effect is to attribute [...] small leading phase shift to the c[...] stant-voltage source, which tends [...] compensate to a certain extent the ov[...] all high-frequency phase lag arou[...] the feedback loop. The resulting add[...] phase lead of about 10° at 100 kc. [...] sufficient to eliminate any tendenc[...] toward oscillation at high signal leve[...] The final amplitude-phase charact[...] istics of the complete amplifier ([...] channel) are shown in Fig. 5C. Calc[...] ated and measured data are inclu[...] for purposes of comparison.

Figure 6 shows a complete schema[...] diagram of one channel of the resol[...] isolation amplifier, including compon[...] values, tolerances, and operating con[...] tions. The major performance ch[...] acteristics of a two-channel protot[...] unit are given in Table 2.

## Conclusion

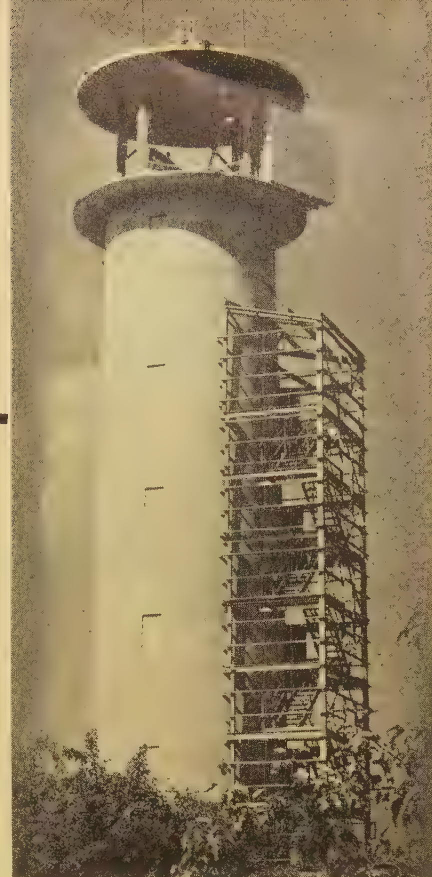
This article has dealt with the t[...] oretical and experimental procedu[...] employed in the development of a hi[...] stability resolver isolation amplif[...] As can be seen from Table 2, the u[...] meets the specifications of Table 1 w[...] adequate leeway for tube changes, [...] ing of components, and other nor[...] shifts in the operating characteris[...] of the electronic components involv[...] Over-all performance of the compl[...] amplifier is excellent.

**Fig. 6. Complete schematic diagram of one channel of the resolver isolation amplifier, including component values, tolerances, and operating conditions. A basic unit consists of two channels made up of a single 12AX7 (one-half section for each channel) and two type 6U8 triode-pentode tubes.**



# TUNED MICROWAVE REFLECTORS

By **SAMUEL FREEDMAN**
Sightmaster of California Co.



Typical microwave relay tower.

*The efficiency of passive microwave reflectors can be increased by "tuning".*

HE common concept that the reflection of a microwave signal from a reflector is comparable to the reflec- of a beam of light from a mirror aulty. It fails to take into account fact that at microwave frequencies wavelength is only a few times rter than the reflector dimensions, ereas the dimensions of a mirror be millions of times greater than wavelength of light. If a radar ector, for example, is 75 cm. in di- eter, it would only be 7½ times ater in dimension than the wave- gth of a 10-cm. (3000 mc.) signal. mirror of the same size would have iameter 1,250,000 times greater than mean wavelength of visible light.

his difference was believed by the hor to be a contributing cause of fact that—in submarine radar tests argets dead ahead could also be de- ed in back of the reflector and at ld" angles. It was also felt to be a tributing cause of the variation of formances with differently adjusted ars and various installations.

t was found that reflectors should tuned for the wavelength of opera- rather than have random dimen- s with respect to some fractional ess of a number of whole wave- gths. This fractional wavelength ex- s can cause standing waves to exist he boundaries of a reflector, thereby rading performance. Steps were en to solve—both physically and thematically—the problem of bound- conditions that exists when a re- ting plane is of finite dimensions. ese efforts resulted in tuned micro- ve reflectors which focus, defocus beam radio signals through space microwave frequencies with an effi- ncy equivalent to that of an infinite ne.

Vork on these microwave reflectors originally started in 1944 by the hor, then Lieutenant Commander in U. S. Navy Submarine Service, and sto Fonda Bonardi, then a Lieuten- in the Royal Italian Navy Sub- rine Service, at New London, Conn. first working model was built the author early in 1945 and tested on an SJ radar on the roof of the U. S. Coast Guard Electronic Technicians School at Groton, Conn., where excellent radar targets were picked up on seagoing craft operating in Long Island Sound. A patent was granted on December 16, 1952, after continuous prosecution by the U. S. Office of Naval Research from the time it was filed, May 9, 1945. Originally classified Secret, this patent has since been declassified and the commercial rights to its exploitation given to the inventors who are now back in civil life.

A tuned microwave reflector is able to achieve an efficiency equivalent to that of an infinite plane because it differs from the usual type of reflector in that it is provided with phase-shifting ends. The ends tend to annul the standing waves on the reflector and avoid undesired radiation proceeding therefrom. These phase-shifting ends improve the efficiency of any kind of surface reflector. For horizontally polarized waves, a flat reflector need only have phase-shifting ends; for vertically polarized waves, vertical wings are added to the edges. The ends and wings are tuned (made dimensionally correct) for the frequency employed and the angle of reflection desired.

This "tuning" process may be better understood by referring to Fig. 1A which illustrates an optical reflection rather than a radio reflection. $S$ represents the source of energy, $A$ represents the receiver or antenna, $C$ is the plane of the reflector, $B$ is the point at which the power from $S$ strikes the reflector, $a$ is the useful area of the receiver, $b$ is the area of the reflector of finite dimensions in the reflecting plane $C$, $S'$ is an imaginary source of energy situated on the other side of the reflector and symmetrical to the real source $S$, $\theta$ is the angle of incidence, $r_1$ is the distance from the source to the point of reflection $B$, and $r_2$ is the distance from the point of reflection $B$ to the receiver $A$.

Assuming that $r_1$ is the distance between a radar detecting station and a target and that $r_2$ is the same distance back (say, 10 miles each way), the following differences will exist between finite and infinite reflector conditions:

*Finite Case:*

$$\text{Power} = \frac{k}{(4\pi r_1 r_2)^2} = \frac{k}{1.577 \times 10^6}$$

*Infinite Case:*

$$\text{Power} = \frac{k'}{4\pi (r_1 + r_2)^2} = \frac{k'}{5024}$$

Since $k$ has been mathematically found never to be greater than $k'$, the ratio of efficiency favors the infinite case.

For communication situations where the outgoing signal proceeds onward rather than returning to the source, the distances represented by $r_1$ and $r_2$ would normally differ. Assuming that the distance from the transmitting source to the reflector $r_1$ is 10 miles and the distance from the reflector to the receiving point or a subsequent reflector $r_2$ is 20 miles, the following would apply:

*Finite Case:*

$$\text{Power} = \frac{k}{(12.56 \times 10 \times 20)^2} = \frac{k}{6.31 \times 10^6}$$

*Infinite Case:*

$$\text{Power} = \frac{k'}{12.56(10 + 20)^2} = \frac{k'}{11{,}304}$$

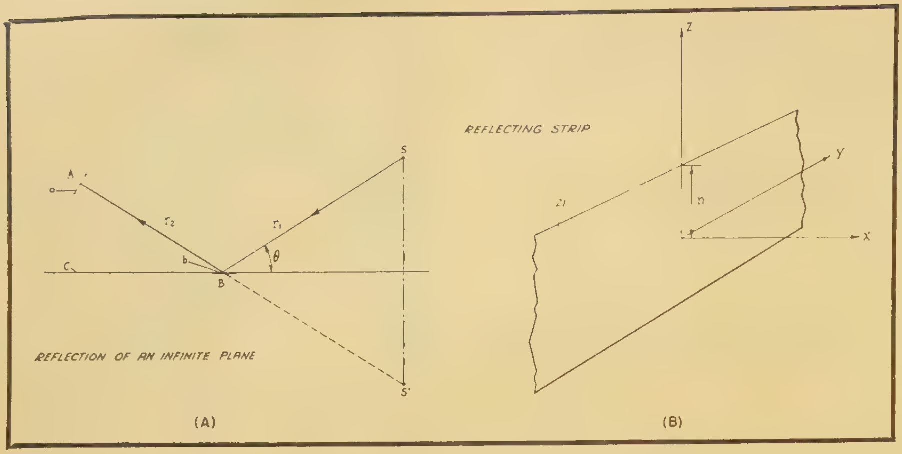



**Fig. 1. (A) The reflection of a plane wave from an infinite reflecting surface. (B) Fragmentary section of a flat reflecting strip shown in Cartesian coordinates.**

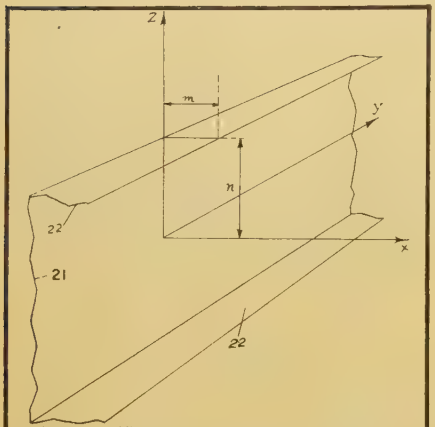


**Fig. 2. Section of wing-type reflecting strip for vertically polarized field.**

Here the ratio of efficiency in favor of the infinite case becomes approximately 6,310,000 divided by 11304, or 486.4 times.

It can therefore be stated that in the finite case the power falls off inversely as the square of the product of $r_1$ and $r_2$, whereas in the infinite case the power falls off only as the square of the *sum* (not the product) of $r_1$ and $r_2$. This important difference in efficiency results from the fact that in the finite case the arriving plane wave system is absorbed and scattered to become a new spherical system which propagates in all directions. In the infinite case, however, the arriving plane wave system still remains a plane wave system after reflection, propagating in a direction symmetrical to that of the arriving system (Fig. 1A).

A plane system of electromagnetic waves does not change its plane characteristics if at any point in space Maxwell's equations can be satisfied by the equations of a plane wave propagation, both for the electric field and for the magnetic field. Maxwell's equations provide some kind of equilibrium between the electric field and the change in the magnetic field at every point in space, and they provide a similar balance between the magnetic field and the change in the electric field. Whether this change results in a displacement current or in a conduction current is inconsequential.

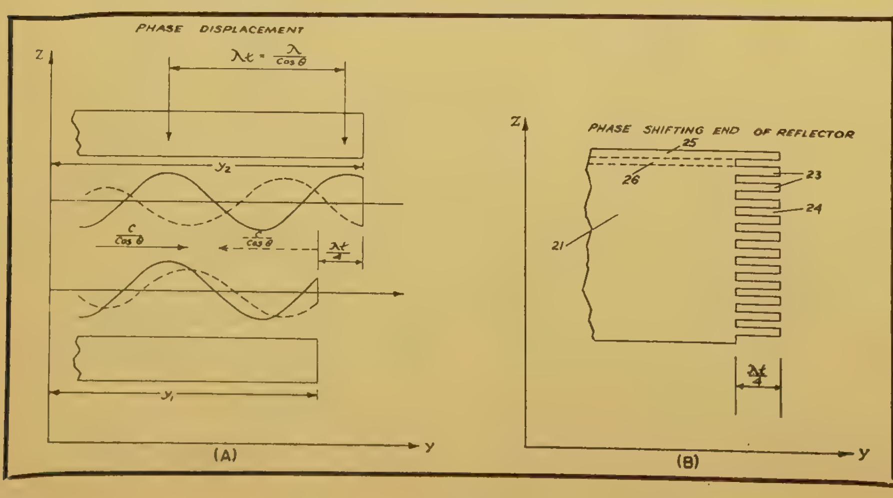
In the case of an abrupt change in the means of propagation, such as the presence of a conducting surface, i[s] necessary to replace the displacem[ent] current in the space beyond the [con]ducting surface by the actual con[duc]tion current in the surface in orde[r to] maintain the balance with the magn[etic] field at the surface. In the case o[f a] single arriving system of energy, [the] balance can be maintained only by [the] additional presence of a reflected [sys]tem, so that the resulting field wil[l be] balanced by the current set up by [the] first system in the conducting surf[ace]. If this conducting surface has to re[flect] a plane system, the currents which [cir]culate in it must be such as to bala[nce] the field resulting from the simu[lta]neous presence of an arriving pl[ane] wave system and a reflected syst[em]. This balance can be accomplished [by] proper choice of reflector shape.

A field polarized in the plane conta[in]ing the source and the center of [the] reflector requires a flat sheet, as [in] Fig. 1B, wherein 21 represents a fr[ag]mentary section of a flat reflect[ing] sheet having a width of $2n$ and be[ing] in the *Y-Z* plane. A field polarized p[er]pendicularly to that plane requires [the] addition of two wings of definite wi[dth] to the same flat sheet, as in Fig. [2,] wherein the reflecting sheet 21 is p[ro]vided with a wing 22 of a width $m$ u[pon] each edge. The wings 22 are sho[wn] parallel to the *X-Y* plane while [the] reflecting sheet 21 is in the *Y-Z* pla[ne], i.e., the wings 22 are perpendicular [to] the reflecting sheet 21.

In both cases, the nearest end of [the] reflecting sheet 21 and the opposite [end] should be cut in a series of project[ing] strips 23 of a definite length, as sho[wn] in Figs. 3B and 5, in order to insure [the] proper distribution of currents near [the] end of the conducting surface. Fig. 3B shows a fragmentary end section [of] a flat reflecting sheet 21 having a se[ries] of projecting strips 23 extending fr[om] the end. The space 24 between the str[ips] is of the same width as the stri[ps]. These projecting strips may be c[on]sidered as being merely extensions [of] imaginary strips 25, indicated by [the] dotted lines extending the compl[ete] length of the reflector. The adjac[ent] portions 26 of the reflector may t[hus] be considered as being similar strips [of] shorter length. Each strip 25 and [its] adjacent strip 26 form a so-cal[led] phase-shifting couple, the purpose [of] which is more fully explained bel[ow]. The reflector is composed of one or m[ore] of these phase-shifting couples.

In the case of the wing reflector, e[ach] projecting strip 23 must carry its o[wn] wings of the same width as the s[heet] wings 22 (Figs. 5A and 5B). Fig. 5A shows a fragmentary section of [an] arrangement of the wing type reflec[tor] wherein 21 is a flat reflecting sheet h[av]ing projecting strips 23 extending fr[om]

**Fig. 3. (A) Phase displacement resulting from difference in length of two reflector strips. (B) Section of reflector showing phase-shifting end used for tuning.**



e ends, as in Fig. 3B. This reflector so has wings 22 perpendicular to each ıter edge, as in Fig. 2, and in addition ıs wings 27 of the same width as the ings 22 upon each of the side edges the projecting strips. Figure 5B ows another arrangement of the wing pe reflector which is identical to that Fig. 5A with the exception of the osed ends on the strips 23. Closures are provided on the outer ends of e strips between the wings, and cloıres 29 are provided at the inner ends.

The length of the projecting end rips 23

$= \frac{\text{wavelength along the reflector}}{4}$

$= \frac{\text{wavelength in free space}}{4 \cos \theta}$

ıd the width of the wings 22

$= \frac{\text{wavelength in free space}}{4 \sin \theta}$

here $\theta$ is the reflection angle.

The phase displacement resulting in length difference in the projecting rip between two strips 26 is shown Fig. 3A. The direct wave is shown a full line and the reflected wave by e dotted line. It may be seen that the flected waves are 180° out of phase on e two strips. Their fields thus destroy ıch other so that the total effect is a ck of back radiation. A reflector may mprise a number of such strips where ıch pair, in turn, comprises an elemenıry or unit reflector—the narrower e strips, the better the result.

The strips which form the phaseıifting ends and the wings must be ıned both for frequency and direcon. Change of frequency or direction fects the efficiency of the reflector as otted in Figs. 4A and 4B. Figure 4A a polar diagram showing the change reflected power and percentage of ficiency vs. change of direction for a ries of stated frequencies. Figure 4B a Cartesian diagram showing the ıange of reflected power and percentıge of efficiency vs. the change of freıency for a series of stated directions. he symbol $\omega_0$ in Fig. 4 represents the ıtoff frequency of the reflector. The ıtoff frequency is that which has e maximum power reflection at zero flection angle, beyond which reflecon no longer occurs. It is the lowest equency that the reflector is able to flect with maximum efficiency. The ıtoff wavelength will be four times nger than the strips which comprise e phase-shifting ends if the reflection ıgle is equal to zero. The reflection ıttern for a stated reflector therefore epends upon the length of the phaseıifting ends, which determines the cutf frequency. By using Fig. 4A, it is ssible to determine how the reflection ficiency changes with a change of reection angle for stated frequencies eater than the cutoff frequency. This is done by finding the intersection of the curve identified by the desired frequency, with a line drawn from the left corner (center of the polar diagram), and making the desired angle with the abscissa. The length of the radius from the center to this point, transferred on either side of the graph, indicates the percentage of efficiency directly. The best reflection angle for every frequency is written under the line which departs from the most external point of every curve.

Assuming that the desired reflection angle is 45° and that a frequency 1.3 times the cutoff frequency is used, a line is then drawn from the left corner which makes an angle of 45° with the abscissa. The intersection of this line with the curve labeled 1.3 is then marked. Using the length of the line from the center to this point as a radius, an arc is laid off on the chart. The efficiency is found to be approximately 97% for 45°. If a reflection angle of 60° and the same frequency (1.3 times cutoff value) are used, the

(*Continued on page* 27)

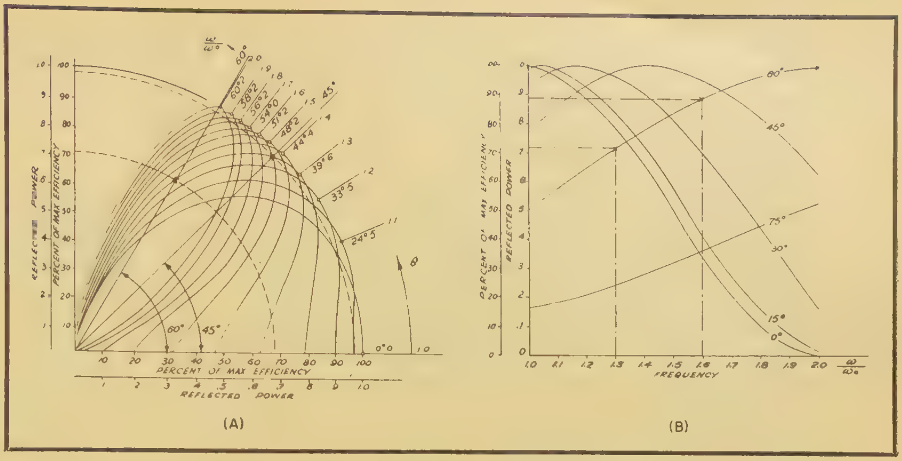



**Fig. 4. (A) Reflector polar diagram showing reflected power and % efficiency vs. change of direction for various frequencies. (B) Cartesian diagram showing reflected power and % efficiency vs. change of frequency for various directions.**

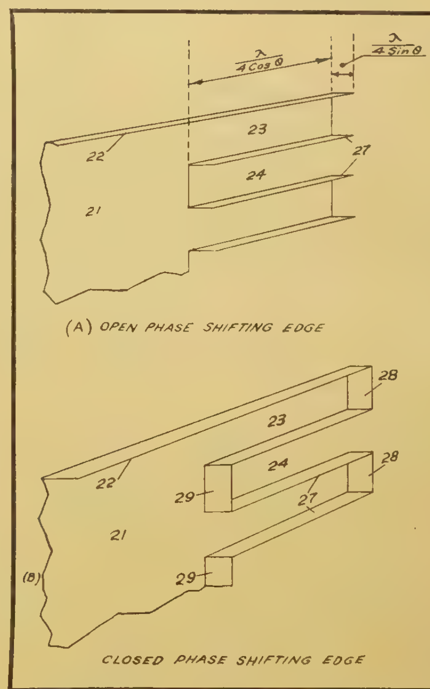
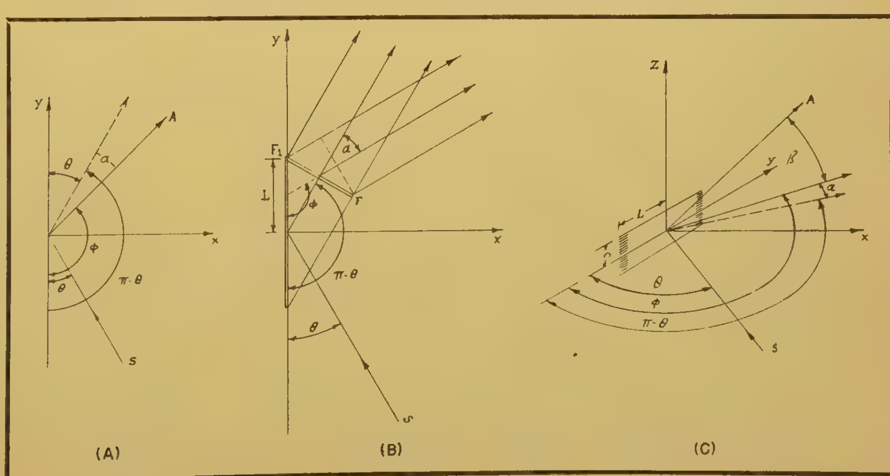



**Fig. 5. Sketches showing modifications of the phase-shifting ends.**

**Fig. 6. (A) Diagram indicating lack of symmetry when antenna is moved with respect to reflector and source. (B) Diffraction effects for position illustrated in (A). (C) Diagram portraying unsymmetrical condition when antenna moves out of X-Y plane.**



# REMOTE TEMPERATUR

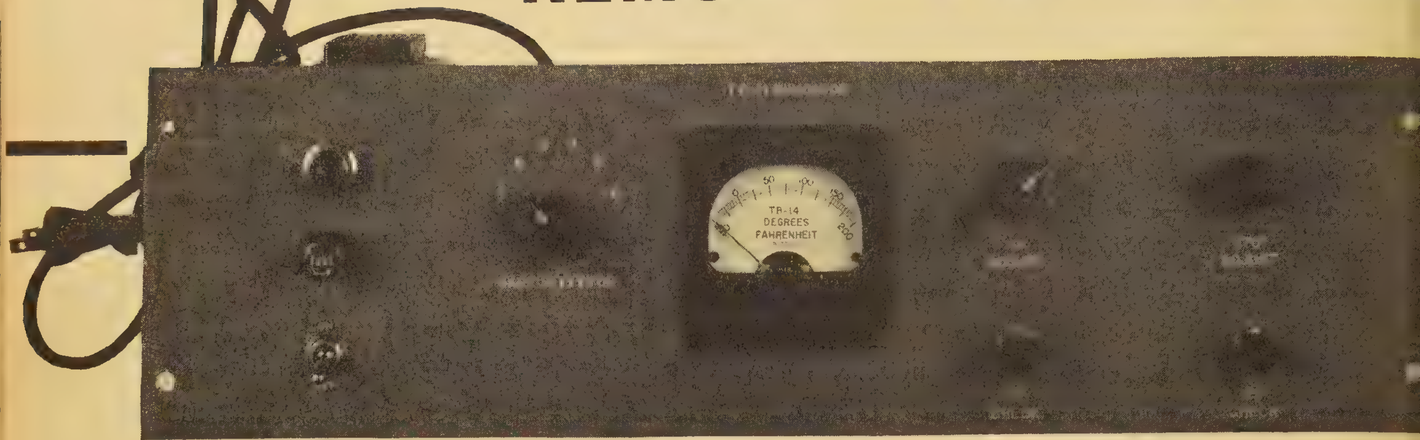



Fig. 1. Front panel view of the direct-reading temperature indicator. Meter is calibrated in ° F.

THE EQUIPMENT to be described here was developed to measure temperatures between −50°F and +200°F inside of electronic "packages" within a guided missile during preflight tests. Temperatures in such "packages" must not be allowed to rise above +150°F because of the possible failure of such components as electrolytic condensers, and the presence of a remote-reading "thermometer" is a good check on the efficiency of the cooling system that is built into each missile.

One type of remote-reading temperature-sensitive gage is the well-known thermocouple. It is a junction of two dissimilar metals which generates a voltage proportional to the temperature of the junction. This voltage is a matter of a few millivolts and must be indicated on a sensitive indicator. The junction is frequently installed by drilling a hole in the structure, inserting the thermocouple junction, and peening the surrounding metal so as to hold the junction firmly. The indicator will indicate (in millivolts) the temperature of the structure; a conversion chart for the particular junction used (such as iron and constantan) will give the temperature accurately. The leads from thermocouple to instrument must be of the same metals as those used in the junction.

For this particular application, it was desirable to use a gage of some kind that could be cemented to a thin metal or plastic section or that could be held in an air space. Such a gage is manufactured by the *Baldwin-Lima-Hamilton Corporation* and is called the TB-14 gage (see Fig. 4). Closely resembling that company's SR-4 strain gages in appearance, the TB-14 utilizes a gage wire whose resistance varies rapidly with temperature, whereas in strain gages the aim is to have constant resistance over a wide temperature range. Another gage, the T-14, is similar in appearance to the TB-14, but is slightly less expensive and ma not be used at such high temperature

For best results, the operator shou use standard strain gage installati techniques of cementing and moistur proofing. To measure surface temper ture, the gage should be cemented the surface and covered with a lay of felt so that the gage resistance w not be affected by drafts. To measu air temperatures, one edge of the ga should be cemented to any convenie structure, and as much of the gage possible should be exposed to the air.

*Baldwin-Lima-Hamilton* also mak gages for sensing temperatures und more rugged environmental conditio such as in corrosive liquids. These gag are protected by stainless steel jacke and can be permanently mounted in t walls of pressurized vessels.

The resistance of the T-14 and TB- gages varies with temperature accor ing to the following formula:

$$dR = R_{70}\ (at + bt^2)$$

where:
$dR$ = change in resistance above $R_{70}$
$R_{70}$ = resistance at 70°F
(nominally 200 ohms)
$t$ = temperature rise above 70°F
$a$ = $2.41 \times 10^{-3}$
$b$ = $1.92 \times 10^{-6}$

This formula gives good accuracy ov the range of 0 to +350°F. The man

Fig. 2. Circuit diagram and parts values for the temperature indicator.

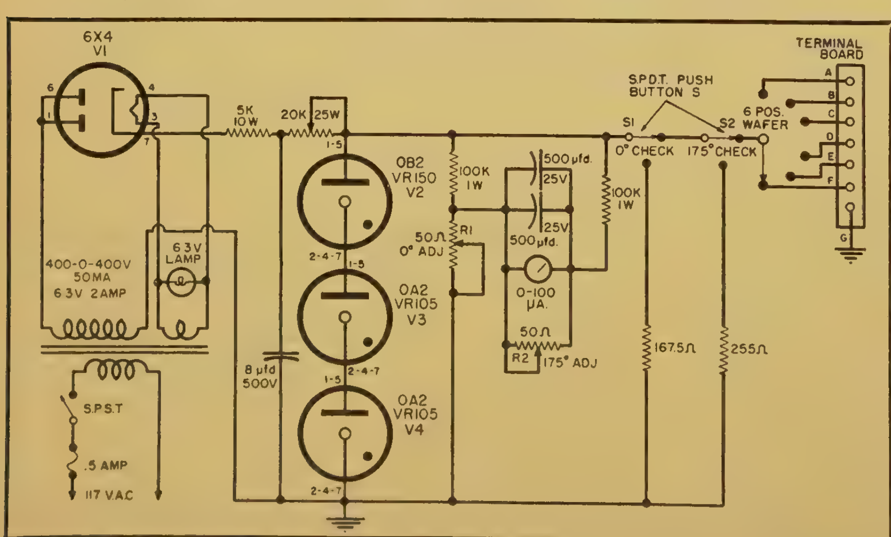
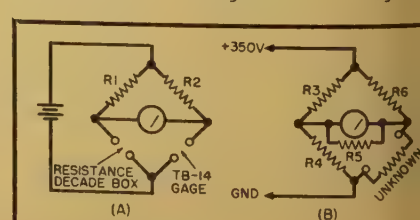



Fig. 3. (A) Conventional Wheatstone bridge for measuring gage resistance (B) Equivalent circuit of the instru ment which is diagrammed in Fig. 2



# IEASUREMENT

WAYNE TUSTIN

*direct-reading Wheatstone bridge arrangement*
*licates temperature of a resistance-wire gage.*

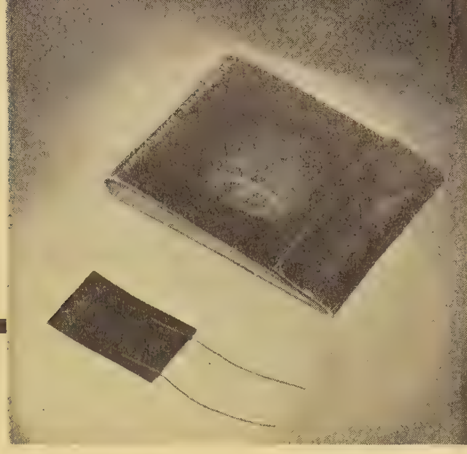


Fig. 4. Gage shown with a book of matches.

turer provides the value of $R_{70}$ for h individual gage. A manufactur- tolerance of $\pm 4$ ohms or $\pm 2\%$ is ntained.

o determine the temperature, using type gage, the operator must meas- the gage resistance. This can be sured by means of a Wheatstone lge as shown in Fig. 3A. If $R_1$ and are equal, and if the decade box is tinuously adjusted so as to keep the er at zero, the value of the decade stance and the value of resistance of TB-14 gage will be equal; and con- sion by means of the table enclosed n each gage will yield the value of perature.

he system shown in Fig. 3A was ially used for a time in the original led missile installation. A six-posi- selector switch allowed one instru- nt to be used with six different gages, n mounted in a different part of the sile.

ince this method is obviously cum- some, due to the need for continuous ncing and reference to charts, the rability of a system that would en- the operator to check temperature e every five seconds, and to know temperature without looking at a rt, led to the development of a di- -reading version of the Wheatstone lge. This direct-reading instrument hown in Figs. 1, 5 and 6. It is built on a standard rack panel, 5¼" x 19".

The schematic circuit is shown in Fig. 2, while Fig. 3B depicts an equivalent circuit. Less than 1 volt exists across the gage leads. A six-position selector switch is again provided to enable the operator to check temperatures at six locations.

The gages are installed in the electronic "packages" during manufacture. The gage voltages come out of the packages and eventually out of the missile ground test connectors in the same connectors and cables as other voltages. Ordinary copper leads are used. Since lead resistance is read by the instrument, these leads should be quite large if a long cable is necessary. If the readings were taken 100 feet from the gage, and if 200 feet of #20 wire were used, the error would be +2.1 ohms, or +4° at room temperature. Use of #14 wire would reduce the error to less than 1°.

Prior to operation, the instrument should be allowed to warm up for a minute. The gage selector switch position desired for the previously installed gage is then selected. The meter will read some value between zero and full scale. $S_1$ should be pressed and $R_1$ adjusted so that the pointer rests at 0°. This replaces the TB-14 gage with a precision resistor of 167.5 ohms, which is the gage resistance at 0°. $S_2$ should then be pressed and $R_2$ adjusted so that the pointer is at 175°. This replaces the gage with 255.0 ohms, the gage resistance at 175°. These adjustments should be repeated twice before the instrument is actually used; they need be checked no oftener than once per hour.

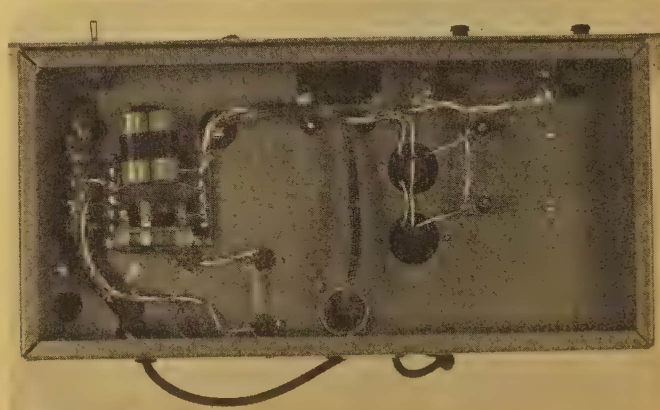
With this system, an accuracy of $\pm 5\%$ or $\pm 5°$ is achieved at midscale, sufficient for the application. Six gages can be read in ten seconds; the speed with which temperatures may be read has caused this method of measurement to be widely used. During guided missile manufacture, one of the units described above is installed at each missile test position.

Table 1. Calibration of a typical gage based on the formula given in the text.

| Temperature (° F) | Resistance (ohms) |
|---|---|
| -50 | 144 |
| 0 | 167 |
| 50 | 191 |
| 70 | 200 |
| 100 | 215 |
| 150 | 241 |
| 200 | 268 |
| 250 | 298 |
| 300 | 324 |
| 350 | 364 |
| 400 | 400 |
| 450 | 440 |
| 500 | 484 |
| 550 | 531 |

Fig. 5. Top view of the temperature indicator.

Fig. 6. Underchassis view of the complete unit.



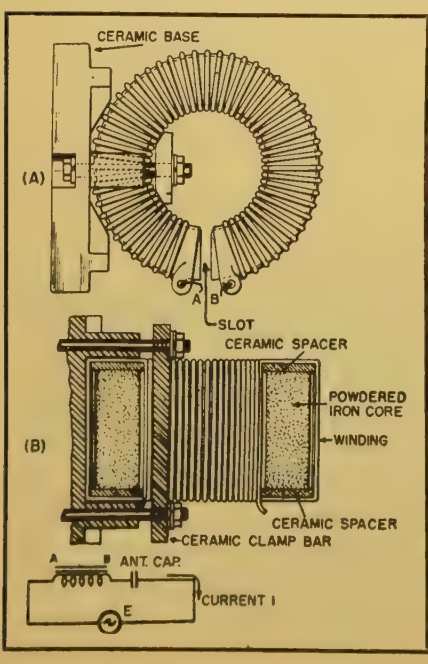
# HIGH Q TOROIDAL INDUCTANCE

By **SIDNEY WALD**

*A Q of 600 in the 500-3000 kc. range has been achieved in this antenna loading coil design.*

THE high performance toroidal coil described in this article has a number of outstanding technical properties which should help solve many of the problems confronting designers of electronic circuits operating in the frequency range of 500-3000 kc. With an inductance of about 40 μhy., the coil has a *Q* of over 600 at 1 mc. and a distributed capacity of only about 5 μμfd. When it is further described as being in the form of a small cylinder having an outside diameter of only 2" and a length of 1", with negligible external field, a large number of applications may suggest themselves.

**Fig. 1. The high Q r.f. toroid.**




This coil was first developed for a requirement that called for an antenna series-loading inductance as part of a 50-watt airborne communications transmitter. At the lowest frequency for which the equipment was designed, the short antenna into which the transmitter was to operate had a radiation resistance somewhere in the vicinity of 2 ohms, with a capacitive reactance of about 500 ohms. Tuning such an antenna to series resonance by means of a loading coil would result in a current of 5 amperes r.m.s. unmodulated and a peak carrier voltage of 3500 volts across both the loading coil terminals and the antenna-ground terminals. For 100% modulation this voltage would be doubled, thus presenting a most formidable problem in coil design.

The large antenna current obtained under these circumstances necessitates reduction of all series antenna tuning resistances to the absolute minimum if a substantial portion of the available transmitter power is to be delivered to the antenna. Thus, with a loading coil *Q* of at least 500 (equivalent to a series resistance of one ohm), the power in the antenna would be at least double that lost in the tuning circuit. Starting with 50 watts, 17 watts would be lost and approximately 33 watts radiated.

Conventional helical inductances were considered and almost immediately discarded because of the lack of space in the small pressurized antenna tuning compartment of the transmitter. Such crowding would not only have lowered the *Q* disastrously but would also have considerably aggravated the problem of insulating the coil for the 7000 volts developed at series resonance.

The toroidal form of inductance gested itself at once as the ideal solu provided the necessary low losses, quired inductance, and ability to w stand severe heating and large r.f. rents could be achieved in compact f

Figures 1A and 1B show the component. The coil is wound on a indrical shell of powdered carbonyl obtained from *Henry L. Crowley & Inc.*, of West Orange, N. J.,—their T D-1 SS.

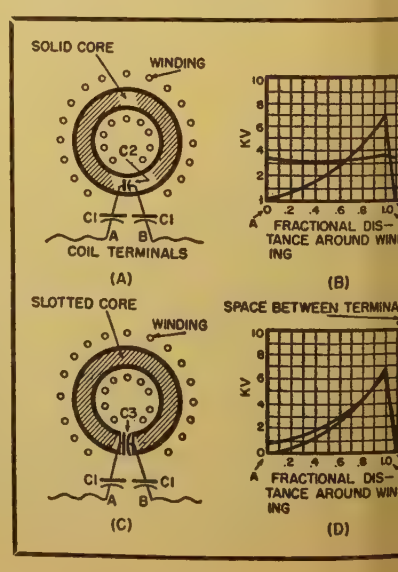
Dimensions of the core are: O.D.– I.D.—1¼", length—1". A ⅛" slot is through and two steatite or Myc caps cemented on either side of the with Insl-X.#85 or #95, and assembly is then baked for one hou about 80° C to cure the bond.

Using litz wire (240 strands of # supplied by the *Philadelphia Insul Wire Company*, approximately 46 t are wound evenly around the core shown in Figs. 1A and 1B. Terminat may be made to eyelets in the cera caps which space the wire from the c A suitable ceramic base and clamp used to mount the assembly on a m chassis.

The provision of a slot or air-ga the core may be somewhat baffling first glance. Actually, it has two poses; one is to simplify the task winding, and the other—far more portant—is to reduce the voltage di ence between the coil and core t minimum along the winding. This be clarified by referring to Fig. 2A. cause of the high dielectric cons (about 28) of the iron core mate with 7000 volts across the coil termi 3400 volts appear between each term and that portion of the core immedia

(*Continued on page* 23)

**Fig. 2. (A) Solid core: voltage acros A-B, 7000 v.; $C_1$, 3400 v.; $C_2$, 200 v (B) Voltage distribution with solid core (C) Slotted core: voltage across A-B 7000 v.; $C_1$, 500 v.; $C_3$, 6000 v. (D Voltage distribution with slotted core**



# NEW PRODUCTS

### MEMORY UNIT

Composed of a solid acoustic delay line and associated circuitry, the Model 3C1-384 memory unit is a complete package ready for installation in a computer—the entire memory circuit is included in one plug-in type chassis. Used in groups in a computer, a complete memory circuit can be removed easily for servicing and a spare unit plugged in to keep the computer operating. Over-all dimensions of the plug-in chassis are 4½″ x 5½″ x 10″.

Model 3C1-384, developed by the *Computer Control Company*, 106 Concord Avenue, Belmont 78, Mass., stores 384 bits at a pulse repetition rate of 1 mc. A self-contained heating element and thermal control gives temperature stability to the quartz line, and inherent accuracy of delay control greatly exceeds design requirements. The unit is especially fitted for airborne use and is insensitive to shock.

### COUNTER-TIMER

The Model 5500 universal counter and timer provides a direct reading of elapsed time between any two events, a direct reading of the number of events that occur during a precise time interval, an accurate means of measuring low frequencies, and a straightforward electronic counting facility. It is being manufactured by *Berkeley*, a division of *Beckman Instruments, Inc.*, 2200 Wright Avenue, Richmond, Calif.

With the *Berkeley* Model 5500, elapsed time over a range of 40 micro-

seconds to 100,000 seconds can be measured directly with a maximum accuracy of ± 10 microseconds. Events occurring regularly or with random distribution at rates from 20 to 100,000 events per second can be counted. Applications include: relay and switch timing, timing of photographic components, and ballistic measurements.

### FOIL-CLAD LAMINATES

Substantial cost savings over hand wiring methods of producing complex printed circuits for electronic equipment, hearing aids, automatic signaling devices, etc., are made possible through a number of foil-clad laminated plastics manufactured by *Synthane Corporation*, Oaks, Pa. Possessing a bond strength of from 4 to 6 pounds, copper- or aluminum-clad *Synthane* is now

available in 36″ x 36″ sheets with foil thicknesses from .00068″ to .0094″.

Accurate circuit reproduction on *Synthane* foil-clad laminates may be achieved by any commercial printing process, such as silk screening or photo-etching. Foil surfaces are guaranteed to be free of wrinkles, pits, scratches and pinholes; and uniform foil thickness assures fine line etching. The bonding adhesive is resistant to moisture and possesses good electrical properties.

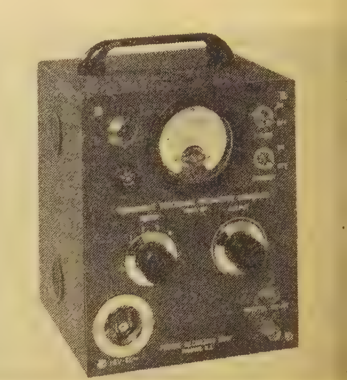
### LIQUID-LEVEL CONTROL

By utilizing an all-cold cathode tube design, the new electronic liquid-level control announced by *Haledy Electronics Company*, 57 William Street, New York 5, N. Y., eliminates the possibility of hot tube failure. This new control, whose only contact with liquids of both high and low electrical conductivity is made by stainless steel rods, does not require any floats, bellows or other moving parts inside a tank.

Incorporating the *Haledy* TT-1 triode tube, the control operates instantaneously and has unlimited life. The high amplification factor of the TT-1 tube permits level detection with great[er ac]curacy.

### SECONDARY FREQUENCY STANDARD

When used in conjunction wit[h a] suitable microwave receiver and au[xil]iary signal generator, the Model



microwave secondary frequency sta[nd]ard will enable foolproof and ra[pid] measurements of frequencies from to 11,000 mc. to an accuracy ± .005%. It has been announced *Presto Recording Corporation*, P. Box 500, Paramus, N. J.

The Model 100 delivers to the 50-c input of a typical microwave recei an uninterrupted series of c.w. sign spaced every 100 and 200 mc. over complete frequency range, and a 50- marker output useful up to appr mately 9000 mc. These signals are delivered simultaneously without frequency tuning.

### IMPEDANCE METER

For the first time, VSWR can measured directly and simply at highest power levels and at any d cycle. The Narda Model 210 high-po VSWR detector, announced by *Nas Research & Development Associa Inc.*, 66 Main Street, Mineola, N. measures the VSWR of dummy loa TR, ATR, system components, ant nas, radar systems, standard m matches for high power magnetro etc., under actual operating conditio and at any power level up to maximum peak power rating of wave guide.

In operation, the Model 210 is c nected in the transmission line operated in the same manner as c ventional low-power slotted sectio VSWR is read directly on a c ventional VSWR amplifier, and ph is determined from the scale and vern mounted on the instrument. At X-ba the Model 210 may be used at po levels in excess of 250 to 300 kw.

### SUBMINIATURE RATE GYROSCOPE

*Sanders Associates, Incorpora* 137 Canal Street, Nashua, N. H., announced production of Model 7

series of precision, subminiature gyroscopes. Less than 2" long 1" in diameter, this gyro weighs 3 ounces. It is hermetically sealed is temperature-compensated.

aximum linear output occurs at an it of 420° per second. Resolution of output is better than 0.05° per nd. Sensitivity is 14 millivolts out- per degree-per-second input. With a.c. output, this unit is useful in raft instruments, guided missiles, ar antenna stabilization, fire control ems and similar applications.

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IIATURIZED PULSE TRANSFORMERS

new line of miniaturized pulse sformers for blocking oscillator lications has been announced by *ytheon Manufacturing Company,* ltham, Mass. Designed with a choice everal different wiring connections, se miniaturized units are available hree different styles. One style has lug-in octal base construction, an- er has a hermetically sealed MIL- 7 construction, and the third is an apsulated version with a built-in er seal for chassis mounting.

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TATE COIL BOBBINS

sed with dielectric paper, acetate vides increased insulation without rifice of the tensile strength of the e material. Acetate coil bobbins for and i.f. coils, relays, push-pull noids, switching, timing and revers-

circuits—and other electronic ap- ations requiring high insulation perties—are now available from the *cision Paper Tube Company* in any , shape, I.D. or O.D., and in any ntity.

hese bobbins can be supplied in all- tate construction, combination ace- e and dielectric paper, and with canized fibre or metal flanges. They be fitted with flanges to meet any cification. In the case of coil forms relays, etc., where brass shading gs are employed to concentrate magnetic field, acetate shields

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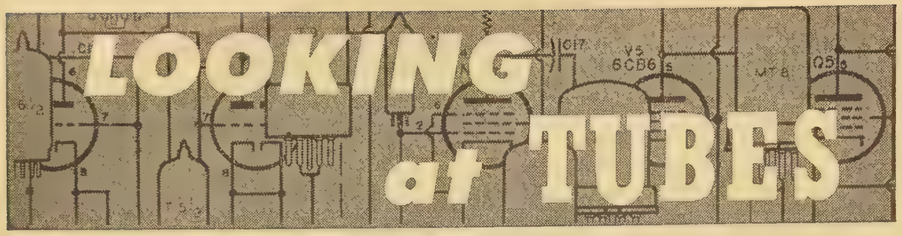


# LOOKING at TUBES


By **WILFRID B. WHALLEY**

**Adjunct Professor of Electrical Engineering**
**Brooklyn Polytechnic Institute**


*Picture reproducing tubes for color television.*

TO ADD COLOR to television requires basic changes in pickup and reproducing devices. For operation of any color television system, the most needed device is one which reproduces the color picture satisfactorily. Intensive efforts over a long period, in both research and development, have been devoted to obtaining satisfactory tricolor tubes.

As discussed previously (RADIO-ELECTRONIC ENGINEERING, May, 1953), color television systems can be divided into two basic groups: those in which the color information is associated with the synchronizing pulse, and those in which the color information is associated with a subcarrier.

In the first group, there is the field sequential color system, where the rate of color switching is low enough so that mechanical control of the colors can be used as well as electronic control. In the second group, the rate of switching color information—from three to four megacycles—is too high for mechanical switching to be practicable.

## Single Tube Display

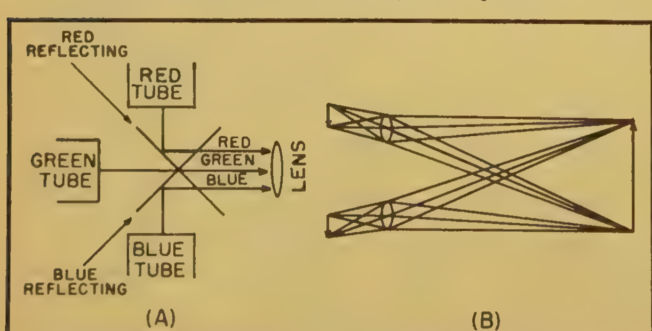
While waiting for satisfactory electronically controlled tricolor picture tubes, field sequential color systems have made use of standard monochrome picture tubes. This has been done by placing color control devices between the picture tube and the viewer.

One arrangement made use of the polarization and refraction of light rays by large, single, translucent crystals. When a high voltage is applied between the two faces of such a crystal, light rays passing through are doubly refracted. Hence, it was possible to build experimental assemblies of two such crystals and—by choosing three successive voltage groupings—pass only the red, green or blue light from the white source of a standard kinescope.

Wratten filters have been used in combination with a rotating color disc or drum, somewhat similar to the type used in field sequential pickup cameras but having necessarily larger dimensions. Color television receivers with 17″ rectangular picture tubes in a suitable color drum have been demonstrated. In this arrangement, the segments of the disc or drum contained red, green and blue filters placed in the same order as those of the camera. The edge of each filter moved progressively downward with the normal downward scanning of the tube electron beam, and by the time the beam recommenced writing at the top of the tube, the next color filter was in position. The disc was locked-in with the vertical synchronizing pulses by one of several methods.

In one of these methods, a small reluctance-type generator was mounted on the shaft of the color disc. The rotor of the generator was so shaped as to produce an output voltage having a saw-tooth waveform. The generator voltage and a negative polarity pulse from the receiver vertical deflection circuit were connected to a phase detector. The output of the detector then controlled the d.c. current through a saturable reactor. Since the disc drive motor was connected through the reactor to the a.c. supply voltage, the speed could be automatically controlled.

**Fig. 1. (A) Registration with three dichroic mirrors and one lens. (B) A method of optical registration.**




Regarding the picture tubes employed with the filters, it was found that relatively large tolerances in the phosphor properties were permissible, so long as the light output contained a reasonab amount of red energy.

Using a standard good-quality pi ture tube, there was no limitation upo resolution in the reproducing devic The resolution obtainable was the sam as for monochrome operation, since th color segments in the disc acted only a light filters and had no effect upon sp size. It may also be noted that the r producing tube had only one electro beam, and therefore there were no prob lems of registration such as can occu with more recent types of multibea tricolor tubes.

## Multiple Tube Display

In those systems which have eith "simultaneous" color or high spee switching controlled from a subcarrie assemblies of three monochrome pictu tubes were first used. Each of the tubes supplied the light image corr sponding to one of the primary color e.g., the red tube was supplied with signal corresponding to the red info mation in the scene.

In one early arrangement called th "triniscope," three projection tub were rigidly mounted in a vertical a sembly, equidistant from each other an with parallel axes. The 3″ tubes we as similar to each other as possib except for the screens which had pho phors to give respectively red, gre and blue light output. Each tube ha a projection lens to focus the rast via a reflecting mirror, onto the ba of a translucent viewing screen. T three lenses were carefully adjust and clamped to bring the three superi posed pictures into as accurate regi tration as possible. Figure 1B is two-dimensional sketch of such an a rangement.

Later, a direct-view three-pictu tube assembly was made (Fig. 1A Three 10″ tubes were mounted in heavy steel frame, one tube with its a horizontal, one vertically facing dow ward, and the third with its axis v tical but face upward. Dichroic mirr placed between the three tube fa brought the three light images togeth for the observer and also provided t color information.

Such operation required rigid m chanical supports for the tubes a three deflection yokes as similar in c struction as possible. The horizon axis of each yoke had to have the sa angle with respect to the vertical ax within a few minutes of arc, so that three rasters would be of similar sha Also, the width, height and center circuits had to be carefully adjusted order to obtain reasonable registrati Even a very small difference betw one yoke and another could cause el trical misregistration of the th images over one or more portions of scene.

## h Q Toroid

tinued from page 18)

cent to it. Only about 200 volts ap- across the small portion of solid included between the terminals. re 2B shows the voltage distribu- on both core and coil referred to end (A) of the winding. The great repancy between the potential of the and that of the coil causes heating e core and increases the possibility ashover occurring on modulation s.

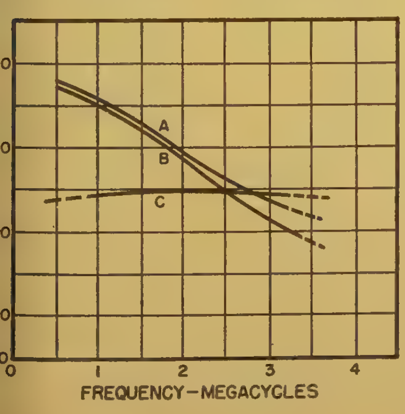
gures 2C and 2D show the condition prevails when a large air-gap is in the core between the coil ter- ls. Capacity between terminals ugh the core has been drastically ced, thus transferring the high age difference from the "coil-to- " gap to the "iron-to-iron" gap. The lting favorable voltage distribution g the coil and core is illustrated in . 2C and 2D.

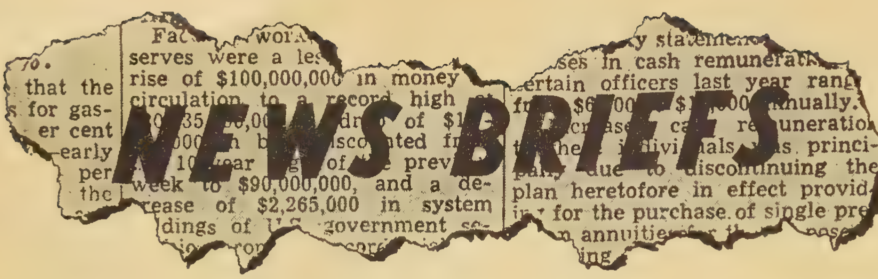
e net effect of the air-gap in the as just described is not only to pro- the toroid against high voltage over in high power r.f. circuits but to increase the *Q* by reducing ectric losses in the powdered iron .

igure 3 shows how the *Q* of such oroid varies with frequency with litz and solid wire, air-gap and l core.

evelopment work on this low-loss id was performed while the author employed by the *RCA Victor Divi-* of the *Radio Corporation of erica* in Camden, N.J. All *Q* meas- ments were made with the *Boonton* e 160-A *Q* meter, with readings ected for distributed capacity.

g. 3. Frequency vs. Q for three differ- t coil and core combinations. Coil A s a slotted core and is wound with a gle layer of 46 turns of 240/44 litz re; inductance, 40 μhy. Coil B has a lid core wound with 240/44 litz wire. il C has a slotted core wound with .040" ameter solid copper wire. Core materi- is Henry L. Crowley #D-1 SS carbonyl ith an outside diameter of 2" and an side diameter of 1¼". Each coil is aced approximately 1/16" from the core.






### IONOSPHERE RECORDER

Due to increased interest in low-frequency radio propagation phenomena, the National Bureau of Standards has developed a low-frequency recorder to probe the ionosphere. Operating frequencies of 50 to 1100 kc. are produced by using the beat frequency method of generating wide frequency sweeps. Wide-band transmitter ampli-

fiers, which utilize transformers containing ferromagnetic cores, deliver over 200 kw. of pulsed power; but an inefficient antenna system must be used because of physical limitations.

The rack at the left of the photograph contains mixing equipment for producing the difference frequency between two oscillators (in the adjoining rack), one of which is a continuous-wave oscillator variable in frequency from 2 to 3.1 mc., the other a pulsed oscillator at a fixed frequency of 2 mc. The final amplifiers are in the plastic-enclosed unit at the right.

### WESCON PROGRAM

The technical program for the Western Electronic Show and Convention, to be held in San Francisco, August 19-21, will consist of 17 sessions with approximately 85 papers to be given. WESCON is jointly sponsored by the IRE (Seventh Region) and the West Coast Electronic Manufacturers Association.

Subject to minor changes, the program will include: two sessions each on antennas, propagation, electron devices, circuits, and computers; and one session each on airborne electronics, microwave techniques, servos and telemetering, instrumentation, transistors, and nuclear radiation measurements. Of the evening sessions scheduled, one will be on medical electronics, another on audio, and a third on generalized topics of broad scope.

### PCA EXPANSION

*PCA Electronics Inc.*, 2180 Colorado Avenue, Santa Monica, Calif., has announced an expansion of its activities to cover commercial and military types of transformers and toroids in addition to the *PCA* line of miniature pulse transformers. Standard filament transformers, plate transformers and chokes designed to meet MIL-T-27 test specifications are now available.

### P2V-5 FLIGHT SIMULATOR

With the delivery of the first P2V-5 Flightronic airplane simulator, the Navy now has an economical and safe method of training pilots and copilots to fly the long-range flying arsenal. Designed and built for the Special Devices Center, Office of Naval Research, by *Engineering and Research Corporation* of Riverdale, Md., this device is the electronic equivalent of the P2V-5.

The *ERCO* flight simulator is basically an electronic computer in which all the forces acting on the airplane in flight, including the pilot's control

forces, are considered as items in a number of equations. The "computer" solves these equations instantly and continuously, and the answers provide instrument indications identical to those of the aircraft.

### RESISTOR MEASUREMENTS

A three-year study of multimegohm resistors has recently been completed by the National Bureau of Standards, the results of which indicate that m[...] resistor types have erratic fluctuati[...] that vary from 1 or 2% to more t[...] 10%. Even the best resistors h[...] variations of from 0.5 to 1%. The st[...] also showed that voltage changes from 1.5 to 180 volts cause resista[...] variations ranging from 0.4 to 26.[...]

Resistances were measured to an [...]curacy of 0.1% by an NBS techni[...]

which utilizes a vibrating reed el[...]trometer as a null detector in a bri[...] network and involves the use of sta[...]ard resistors either directly as co[...]ponents in the circuit or as auxilia[...] calibrating units to replace the [...]known resistor. As shown in the pho[...]graph, the charge flowing through [...] resistor during the time of measu[...]ment is obtained from a varia[...] air capacitor maintained at a fi[...] potential. The potentials across [...] capacitor—and thus across the resis[...]—are obtained from a potential divi[...] and are monitored by the electromet[...] A null condition is maintained by [...]creasing the capacitance at the pro[...] rate by means of a speed-controlled [...] motor geared to the shaft of [...] capacitor.

### INDUSTRIAL APPOINTMENTS

Recent appointments to the techni[...] staff of *Designers for Industry, I[...]* Cleveland, Ohio, an industrial prod[...] development organization, inclu[...] Patrick E. Lannan, Theodore H. Smi[...] and Dr. Charles H. Lutz, as assista[...] project managers; Robert B. App[...]gate, as senior project designer; a[...] Erwin W. Graham, as project design[...]

Mr. Lannan will be responsible [...] electronic development projects at t[...] company together with Mr. Smith a[...] Dr. Lutz; Mr. Smith was promoted [...] his present position from senior proj[...] designer.

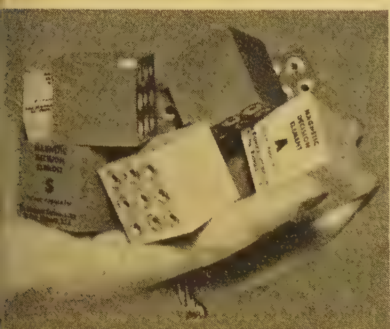
### "AUTOMATION" DISPLAY COACH

"Automation" has been put on whe[...] by the *Westinghouse Electric Corpo[...]tion.* As the theme of a unique disp[...] coach developed by the Standard C[...]trol Division, it is being taken direc[...] to design engineers, maintenance m[...] and supervisory personnel in [...] machinery manufacturing indus[...] throughout the United States. A mo[...]

›ination of the best features of an torium and exhibit hall, the coach ’s how common electrical devices as linestarters, control stations, ›rs, and circuit breakers—the “nuts bolts” of any electrical system—be used to achieve successful auto-›on.

### ›NETIC DECISION ELEMENTS

agnetic decision elements, now ꞡ produced by *The Minnesota Elec-ics Corporation*, 47 West Water et, St. Paul 1, Minn., are com-›ly basic, completely flexible build-›locks. Using only two types, termed and “A,” it is possible to build the



›e arithmetic, program, control and ›ory sections of any digital com-r—including both serial and paral-ystems.

The standard “S” and “A” elements are designed with *Hubbell* interlock connectors for rapid cascading in any desired performance pattern. They contain no electron tubes or transistors. All components are cast in an epoxy type of resin.

## Pressure Testing

(*Continued from page* 8)

be obtained by tests of one or two tubes, since they represent too small a sample. The pressure tank must be large enough to accommodate a number of tubes at one time, thus allowing tests to be conducted on a group of tubes to obtain more reliable data. The tank now in use for this purpose at Seneca Falls has a capacity of 800 cu. ft. and is 27′ long by 6′ in diameter. One end of the tank has a gasketed cover which is sealed airtight by 44 1″ x 6½″ long steel stud-and-nut assemblies. The maximum allowable working pressure of the tank is 60 psi. Safety valves, or “pop-off” valves, are set at the maximum working pressure of the tank. An automatic controlled air pressure system is provided, together with a continuous seven-day pressure recorder. Once the system is put into operation at the desired pressure, the tank may be left unattended except for regular checks on the progress of the test.

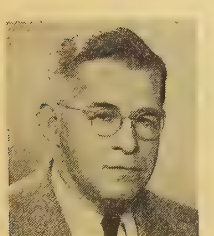
Tests are usually conducted on groups of ten or twelve tubes at a time. Each tube is placed in a cardboard carton to protect it from flying particles in case a nearby tube fails. In order to monitor each tube from outside the tank and to make a daily check on tube failures, electrical cables are connected to the filament of each tube. The cables are then passed through a pressurized fitting in the tank and finally terminated at an indicating device. This device consists of a transformer in series with a group of microswitches. Each switch, when depressed, isolates the tube being monitored and checks for continuity of filament by means of a current meter. (See Fig. 2). If the tube has failed, there will be no current indicated on the meter.

When tests are conducted in the air tank upon bulbs which have no filaments, i.e., unfinished tubes, a trigger mechanism is attached to each bulb. This closes a control circuit in the event of tube failure and records it at the outside control position which is under observation of the operator.

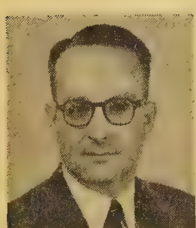
Tests are being run continuously in this tank on all types of glass and metal bulbs and tubes. The data compiled has yielded valuable information on the mechanical properties of picture tubes.

# Personals

**DR. MICHAEL J. DiTORO** will head electronic development in the engineering department of the *Fairchild Guided Missiles Division* of *Fairchild Engine and Airplane Corporation*, Wyandanch, L. I., N. Y. Well known for his work in communications and missile instrumentation, Dr. DiToro was associate director of the Microwave Research Institute of Brooklyn Polytech for a time. He has also filled important engineering posts in leading electronics firms.

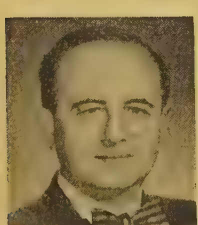


**EDWIN B. HASSLER,** who was formerly with *Motorola Inc.*, has been appointed director of engineering to head the new research and development laboratory being opened by the *Warwick Manufacturing Corporation* at 4740 West Madison Street, Chicago, Ill. He will be in charge of radio, television and electronic product development and the testing and improvement of component parts, including transistor and printed circuit research work.



**JOHN H. HOWARD,** senior research engineer in the Research Activity of *Burroughs Corporation*, Philadelphia, Pa., has been named chairman of two professional groups: (1) the 1953 Joint Computers Committee of the AIEE, the IRE, and the Association for Computing Machinery, and (2) the IRE Professional Group on Electronic Computers. Mr. Howard is a Navy veteran of World War II, and holds an M.S. degree in electrical engineering from MIT.

**BERNARD T. SVIHEL** has been placed in charge of the new Electronics Division of *The Kuljian Corporation*, Philadelphia, Pa. With over 15 years experience in the radio and electronics industry, Mr. Svihel has been responsible for extensive design and research work on analog computers, differential analyzers and servomechanisms. He is a former member of the electrical engineering staff at MIT, and was with the Franklin Institute for several years.



**DR. CONSTANTIN S. SZEGHO,** director of research of *The Rauland Corporation* since 1942, has now been appointed vice-president in charge of research. His improvements in cathode-ray tubes and other special tubes have been major contributions to the television tube industry. Before coming to America in 1940, Dr. Szegho was chief of the vacuum tube laboratory for *Baird Television, Ltd.* of London. He received his doctorate in 1931.

**CHARLES E. TORSCH** has been appointed chief television engineer for *The Rola Company, Inc.*, division of *The Muter Company*, which makes sound-reproducing and electronic equipment. With wide experience in the entire field of television circuitry and components—including association in various capacities with *G-E*, *RCA*, and *Bendix Radio*—Mr. Torsch has 15 patents to his credit and is a regular contributor of technical articles.

## Lumped-Constant

(*Continued from page* 7)

what difficult to wind, and breaks e
when being twisted at the tap. Also
smaller the wire size, the higher
resistance, and therefore the gre
the attenuation within the passban

If the design calls for a wire sm
in diameter than #38, it is bes
choose another form diameter and
peat the calculation for the numbe
turns. Where the physical size of
winding is important and the a
calculations require a large form
ameter, the use of universal w
coils can radically reduce the size.
coil should have an inductance equ
$L_1$, and the spacing between coils sh
be adjusted for the correct *M*. Spa
of a good dielectric material, suc
XXXP Synthane or Rexolite, shoul
used to control the spacing between
coils.

After the line is constructed, its
quency response can be measured
either a signal generator or a s
generator and wideband scope or
brated detector. The measuremen
delay vs. frequency is somewhat
difficult, and Kallmann indicate
method which can be used, tog
with the necessary equipment for
measurement. When square-wave
ing a delay line, care must be exer
All leads must be short, the sq
wave generator should be properly
minated, and all connections—par
larly ground leads—should be of lo
ductance. In some cases, the above
will indicate that a matching netwo
necessary. A simple half-section ca
used, or an *m*-derived half-section
an *m* of 0.6. However, as an *m* o
permits both coils to be identical,
value is suggested because of the
plification it allows and because o
excellent results which it is capab
yielding.

There are several methods of
uring the delay and characteristi
pedance of a line after it is constru
however, the following method has
found to be quite simple and of re
ably good accuracy (see Fig. 6).
square wave generator is properly
minated, and the symmetry contr
so that both halves of the square
are of the same duration. Frequen
carefully set to a known value, e.g
kc. The coaxial lead from the gene
to its termination should be as sh
possible. A resistor whose value is
to the theoretical $Z_0$ of the line is
nected from the generator to the
input terminal, and the line's grou
connected to the generator's grou
means of a low inductance cond
To measure the delay, the probe
wide-band scope is connected acr
and *B*, with $Z_0$ purposely misma

waveform on the scope will be sim- the waveform which is sketched g. 8.

the period of the square wave, $\tau_L$ is twice the delay of the line. If scale of the scope is calibrated in cm., the delay can then be easily ured. By adjusting the value of $Z$, tep in Fig. 8 can be made to dis- r, and the value of $R$ at this point characteristic impedance. When ine is properly terminated, the should be connected to $C$ and $D$. response of the line can then be ved. If a portion of each of the capacitors is made up of a trim- capacitor, these trimmers can be ted so that the ripples in the e wave are at a minimum.

ure 1 is a photograph of a com- ally available constant $k$ line, and 11 is a plot of the frequency re- e of this line with the method asurement indicated. Six db of at- ation is a result of the method of urement, and therefore the line has tenuation of 1.6 db below 1 mc. line has found many applications its limitations are not important. such limitation is nonuniform de- ith frequency as indicated in Fig. igure 4 is a photograph of a 100- uare wave before and after being ed by this line.

cost of the line is quite low and ms a very rugged unit which can be incorporated in a new or exist- esign. Where a longer delay is re- d, two or more of these lines may ed in series; where a smaller delay uired, taps are provided at 0.05- intervals.

coil form is a laminated plastic hich has pins driven into it for coil nals and tap points. The rod is d in a modified coil winding ma- , and the coils are wound between ins. The wound rod is then var- d and inserted into the frame the capacitors are connected to it. ls of this construction technique vident in Figs. 1 and 2.

ure 2 is a photograph of a delay which forms a part of a commer- available television synchronizing l generator. Each section of this as a delay of 0.1 μsec.; the total is 18 μsec., and the characteristic dance is 1000 ohms. The frequency nse is down to 3 db at 900 kc., and tal attenuation is 3 db from the ence point of 1 kc. In operation, a c. pulse is fed into the line, and at the required intervals of delay rought out of the line.

ENCES:


skowitz, S., and Racker, J., "Pulse Tech- ues," Prentice-Hall, Inc., p. 113.
chelder, L., U. S. Patent 2,250,461, Filed 28, 1938.
ner, A. H., "Artificial Lines For Video ribution and Delay," RCA Review, Vol. No. 4, December, 1949.
4. Kallmann, H. E., "Equalized Delay Lines," Proceedings of the IRE, Vol. 34, p. 646, September, 1946.
5. Moskowitz, S., and Racker, J., "Pulse Techniques," p. 84.
6. Lester, J. M., "Transient Delay Line," Electronics, Vol. 10, No. 4, p. 14, April, 1946.


## Tuned Reflectors

(Continued from page 15)

efficiency of the reflector will be approximately 72%.

Use of Fig. 4B makes it possible to determine reflection efficiency changes by changing the frequency for a series of stated angles. This graph may be useful if very wide modulation is employed. The change of efficiency is negligible if the frequency deviation is small percentagewise with respect to the carrier and if the carrier is near the maximum efficiency frequency for that angle. Taking a reflection angle of 60° and a frequency 1.3 times the cutoff frequency ($f_c$), a line is drawn normal to the abscissa at the point marked 1.3 on the frequency scale. From the point at which this line intersects the 60° curve, a line is drawn parallel to the abscissa. The % efficiency is read from the point at which this line intersects the ordinate. Using a frequency of $1.3f_c$, the efficiency is found to be approximately 72%. Using a frequency of $1.6f_c$ and an angle of 60°, the efficiency will be found to be approximately 89%. Likewise, a frequency of $2f_c$ will be 100% efficient with an angle of 60°.

The reflection efficiencies plotted in Figs. 4A and 4B refer to a direction symmetrical to that of the direct beam, namely, to the direction in which light would be reflected if the reflector were a mirror. In this case, it is obvious that the light intensity would decrease abruptly by moving off the reflected light beam. The same thing happens with the microwave reflected beam. Figures 4A and 4B give the reflection efficiency for the center of the reflected beam. Moving away from this direction, the reflected power also decreases, although not so abruptly as in the case of the light beam. This decrease is due to secondary lobes which are caused by diffraction. Diffraction, in turn, is due to the fact that the dimensions of the reflector are comparable with the wavelength—the smaller the reflector, the greater the diffraction effect. Diffraction, in this case, may be defined as the deviation of the radio beam from a straight course resulting from the edge effect of a relatively small reflecting surface.

BIBLIOGRAPHY:


U. S. Patent No. 2,622,242.
"Introductory Concepts to Microwaves," a handbook distributed free of charge by Sightmaster of California Co., Santee, Calif.

# NEW LITERATURE

### ELECTROFORMING

The process of electroforming—the production or reproduction of a formed article by electrodeposition of metal—and its various applications are discussed in an eight-page booklet published by *Bone Engineering Corporation*, 701 West Broadway, Glendale 4, Calif. Facilities of the *Bone Engineering Corporation* for the design, manufacture and testing of electroformed products, are also presented.

### SWITCHES

More than 150 types of switches are illustrated in the 16-page catalog recently published by *Wells Sales, Inc.*, including toggle and leaf switches, miniatures, plunger types, roller and wafer switches, vacuum pressure types, circuit breakers, timers, and many others.

Write to *Wells Sales, Inc.*, 333 W. Chicago Avenue, Chicago 22, Ill., for your copy of Catalog No. C-11. Prices and specifications of hundreds of types are listed.

### DRIVE SYSTEMS

*Westinghouse* "Life-Line" AV-drive is a complete, adjustable-voltage drive system—a factory-engineered package. Flexible in application, it may be used wherever control of a d.c. motor from an a.c. power line is required.

Type AV-drive is described in a 16-page booklet available from *Westinghouse Electric Corporation*, Merchandise Mart Plaza, Chicago 54, Ill., which sets forth the advantages of the system, basic operating principles and construction features.

### CAPACITORS

A 28-page brochure, just published by *Aircraft-Marine Products, Inc.*, provides design and test data on AMP "Capitron" capacitors and pulse f ing networks. These components ar signed for the specific requiren of the equipment in which they a be used.

Illustrated with reproduction actual test charts, the book particular attention to "Ampli-f a new synthetic dielectric which n it possible to effect tremendous r tions of size and weight in capac and pulse forming networks. Req for copies should be addressed to *craft-Marine Products, Inc.*, 2100 ton Street, Harrisburg, Pa.

### DELAY CABLES

*Columbia Technical Corp.*, 5 57th Street, New York 22, N. Y. released a four-page folder on Type HH-1500 and Type HH-2000 impedance delay cables which con a general description of the specifications, pulse response diag and a list of specific applicatio electronic circuits.

The outstanding feature of bo these cables is a continuous, uni flexible, low-loss magnetic core v effectively increases the characte impedance of each cable as well a time delay, while maintaining th mensions of standard ⅜" RG coaxial cables.

### TUBE DEVELOPMENTS

Technical advances which make sible the manufacture of better ele tubes and transistors are describ a group of research reports revi in the April issue of the Bibliogr of Technical Reports. General t covered include tube developm magnetron developments, and trans and semiconductor advances.

The April issue of the Bibliogr is available from the Office of Tech Services, U. S. Department of merce, Washington 25, D. C., fo cents a copy. Check or money should be made payable to the T urer of the United States.

### GLASS FIBER INSULATIONS

Three new lightweight acou glass fiber blanket insulations ar scribed in a four-page folder publ by the *Gustin-Bacon Manufact Co.*, 210 W. 10th Street, Kansas Missouri. These blankets weigh o few ounces per square foot or les are said to possess excellent th and acoustical properties.

"Ultralite" is a textile-type, glass fiber insulation bonded tog with a thermosetting plastic "Ultrafine" insulation is compos very fine glass fibers bonded

## VOLTAGE DOUBLER DEMODULATOR

**By A. Q. MORTON**

**WHILE DOING atomic research in England, Messrs. Cockcroft and Walton were faced with the need to increase d.c. voltages available from a.c. sources. They found it convenient to achieve this increase by using the voltage doubler rectifier circuit sometimes found in power supplies. Such voltage doublers can be cascaded to give an output of four or eight times the input, although in practice the output is never just twice the input and too many stages are inefficient.**

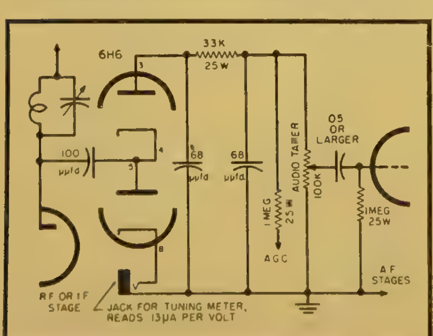
**This voltage doubler has been widely used not only in nuclear research but also in domestic TV receivers where it provides the high voltages needed to use larger or aluminized picture tubes without too much internal change; in these applications high voltage selenium units are employed. The circuit is now coming into use in high fidelity tuners where it will give a better performance than can be achieved with the demodulators generally used.**

**A typical circuit suitable for a 6H6 tube is given in Fig. 1. Each half of the tube acts as an ordinary diode; it passes half the carrier in the form of pulses, the amplitude of which depends on the a.f. modulation. The combination of the pair offers considerable improvement over conventional demodulators, for the inputs are always equal and opposite; so are the outputs, and they are combined in the load resistance just as the outputs of a push-pull stage are combined in an output transformer with the same harmonic cancellation.**

**The price to be paid for this improvement is low input impedance; in the circuit given, the load on the previous stage is about 30,000 ohms, but in high fidelity tuners this might mean no more than the saving of a damping resistor. Tuning is very flat and is best done, as indicated, with a meter. The usual precautions should be taken to insure that the a.f. and a.g.c. resistors are more than five times the load resistor; the low value of the volume control makes this task simple.**

**A test was conducted to determine the distortion introduced by this demodulator. Compared to a single diode on a 5-volt signal 80% modulated, distortion was reduced 18 db. Compared to an infinite impedance demodulator, the improvement was 16 db and a source of a.g.c. was provided.**

Fig. 1. Circuit diagram of the Cockcroft-Walton voltage doubler demodulator with component values.



ermosetting plastic resin; and acoustic" is a combination of the two insulations separated by a e septum.

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**R SUPPLIES**

letin No. L453, covering *Perkin etic* amplifier regulated power es for laboratory testing applica- describes high-voltage and low- ge power supplies with regulations to .15%. This eight-page bulletin be obtained by writing on a com- letterhead to the *Perkin Engi- ng Corporation,* 345 Kansas Street, gundo, Calif.

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**POWER AMPLIFIER**

e new *SIE* Model B d.c. power fier is described in a four-page ure available from *Southwestern trial Electronics Co.,* 2831 Post Road, Houston 19, Texas. Electrical

mechanical specifications are given, ell as a simplified schematic dia- of the unit.

pable of providing substantial t power from standard signal es, this instrument has essential- t response from 0 to 20,000 cps will deliver 6.25 watts into a 100- load when driven by a 10-volt l.

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**RELIABILITY TUBES**

e essential characteristics of *G-E* Star miniature and subminiature reliability tubes are described in oklet published by the *General ric Company.* Included in the data he specific differences between in- ual tubes and their standard-tube types, heater ratings, maximum n center ratings, and operating cteristics.

pies of this eight-page booklet may btained by requesting publication -548-A from the *General Electric pany,* Tube Department, 1 River , Schenectady 5, N. Y.

# TECHNICAL BOOKS

**"PULSES AND TRANSIENTS IN COMMUNICATION CIRCUITS"** by Colin Cherry. Published by *Dover Publications, Inc.,* 1780 Broadway, New York 19, N. Y. 317 pages. $4.50.

Intended as an introduction to network transient analysis for television and radar engineers, this book bridges the gap between simple conventional alternating current theory and operational methods of analysis. Using rigorous physical arguments and only elementary mathematics, it provides the essential groundwork for the study of transients.

Topics covered include: the basis of network analysis, waveforms and spectra of electric signals, selectivity characteristics of networks, transient response of networks, simplification of transient response calculations, characteristics of multistage amplifiers, calculation of the distortion of signals, and the response of networks to very short impulses.

References to many published books and papers appear at suitable points in the text. Mathematical language and notation are avoided as much as possible; electric waveforms are dealt with rather than analytical functions.

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**"MICROWAVE SPECTROSCOPY"** by Walter Gordy, William V. Smith and Ralph F. Trambarulo. Published by *John Wiley & Sons, Inc.,* 440 Fourth Avenue, New York 16, N. Y. 446 pages. $8.00.

One of the aims of this book—the first one to be written on the subject—was to provide for microwave spectroscopists, chemists, physicists, and other scientists a conveniently available source of the large amount of information which has been obtained to date through microwave spectroscopy. This information is summarized in various tables. In addition, a bibliography is provided.

Another objective was to facilitate the analysis and interpretation of the microwave data accumulated. Pertinent formulas are given in forms most convenient for analysis, and numerical tables are provided as an aid in the analysis of the spectra.

This book makes it easy for the beginner to become familiar with the instruments and experimental methods of microwave spectroscopy. The fundamental theory involved in the detection of microwave absorption lines is given with detailed descriptions of spectrographic components.

## New Products

(*Continued from page* 21)

are used to insulate the coil from the ring. For further information, write to *Precision Paper Tube Co.*, Dept. R5, 2051 W. Charleston Street, Chicago 47, Ill.

### MAGNETIC AMPLIFIERS

A line of magnetic amplifiers has been introduced by *Karl-Douglas Associates* for precision control and amplification of a.c. current. These low-cost devices are said to perform the functions of present vacuum-tube or motor-type regulators, but in addition feature instantaneous operation and indefinite life. They are immune to both shock and vibration and are protected by a special plastic potting compound which assures maximum dielectric strength and good

heat transfer. In many cases, they are smaller than comparable vacuum tube circuits.

These amplifiers can be engineered to operate from any single or polyphase a.c. supply voltage at frequencies ranging from the lowest power frequencies to megacycles. Under certain conditions, amplifications of 1 to 1,000,000 are possible. For specific information or an informative folder, write to *Karl-Douglas Associates*, 3160 W. El Segundo Blvd., Hawthorne, Calif.



### COMPUTER MECHANISM

All of the elements needed for precise, high-speed handling of half-inch magnetic recording tape are contained in the computer mechanism for recording and storage of digital data which has been placed on the market by *Raytheon Manufacturing Company*.

The *Raytheon* magnetic tape mechanism may be operated automatically by pulsed input signals or controlled manually by a front panel switch. It moves from stop to start or vice versa in less than five milliseconds, with smooth acceleration, deceleration or reverse. The magnetic head has six channels, narrow gap, with high frequency response. This head assembly is accurately and permanently aligned, although it can be readily removed, replaced, or interchanged.

Inquiries should be addressed to the Technical Sales Department of *Raytheon Manufacturing Company*, Waltham, Mass.

### WAVE GUIDE ATTENUATOR

Direct and precise readings from 0 to 50 db are given by the Model X382A wave guide attenuator which has been developed by *Hewlett-Packard Company*, 395 Page Mill Road, Palo Alto, Calif. Now being offered only for X-band use at frequencies from 8200 to 12,400 mc., the Model X382A has a VSWR of less than 1.15 throughout the range. Zero setting attenuation is less than 1 db.

Readings are completely independent of frequency, phase shift is independent of attenuation setting, and accuracy is within ± 2% of db reading. The design

of this instrument is unique in that the attenuation depends on the angular position of the attenuating film rather than on its specific resistivity. Model X382A employs three resistive films—two mounted in line within each wave guide extension, and a third rotatable axially in the center section. Rotating the center film increases attenu[ation] proportionally to the cosine square[d of] the angle of rotation.

### VARIABLE DELAY LINE

The Type 702 step-variable delay [line] consists of 55 sections of lumped-pa[ram]eter *LC* filter networks. Each se[ction] of these networks was specially

signed to give (1) linear phase s[hift] up to 70% of its cutoff frequency, (2) a frequency response curve w[hich] is Gaussian in shape. As a result, T[ype] 702 produces essentially zero overs[hoot] and has a very rapid rise time—[less] than 0.45 microsecond at any step.

Developed by *Advance Electro[nics] Co.*, P. O. Box 394, Passiac, N. J., Model 702 has a time delay whic[h is] variable in steps of 1 microsecond to 10 microseconds by means o[f a] four-position push-button switch. characteristic impedance is 190 o[hms] nominal for both input and out[put]. Nominal cutoff frequency is 1.27

### CERAMIC MAGNET MATERIAL

"Cromag," a ceramic permanent m[ag]net material, is fabricated by pow[der] metallurgy methods which are ad

## CALENDAR of Coming Events

**AUGUST 19-21** — Western Electroni[c] Show and Convention, Civic Audito[rium], San Francisco, Calif.

**SEPTEMBER 1-3**—International Sig[nal] and Sound Exposition, Palmer House, Chicago, Ill.

**SEPTEMBER 21-25**—Eighth Nationa[l] Instrument Exhibit, Hotel Sherman, Chicago, Ill.

**SEPTEMBER 28-30**—National Electronics Conference, Hotel Sherman, Chicago, Ill.

**OCTOBER 5-8**—Fall Technical Meeting of USA and Canadian National Committees of URSI and the IRE Professional Group on Antennas and Propagation, National Research Council, Ottawa, Canada.

**OCTOBER 26-28—IRE-RTMA** Radio Fa[ll] Meeting, Toronto, Ontario.

o pressing in a wide variety of ate shapes with no machining sary. It can be supplied in long tubes, and square, rectangular, or symmetrical shapes by *Henry L. ey & Company, Inc.*, West e, N. J., and is applicable in rous fields.

htweight and magnetically hard, ag has exceptionally high coercive and at the same time has a re- induction suitable for a wide y of applications. Its stability it ideal for use in applications it must be subjected to high de- etizing fields. In high frequency ations, Cromag shows a very low nd minimum proximity effect on ated circuitry.

---

### SISTOR TEST SET

testing the small signal behavior int-contact and junction transis- the Model T-61 transistor test set ures four independent parameters e four-terminal equivalent circuit transistor. These measurements e carried out over the complete ting range of the transistor, and lead directly to quantitative data d for circuit design.

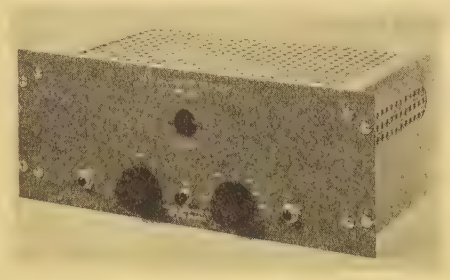
del T-61, which is being marketed *ransistor Products, Inc.*, Snow Union Streets, Boston, Mass., con- separate metering circuits for

pplied d.c. currents and voltages, cision single-frequency audio oscil- and a precision vacuum-tube volt- for direct reading of the param- n under test. Over-all accuracy is

---

### PPER STABILIZER

*lbfell Laboratories, Inc.*, P. O. 1578, San Diego 10, Calif., has announced the availability of the Model 122 chopper stabilizer. Having a self-contained power supply, this unit



affords absolute calibration of output voltage in prescribed steps, with a long-time stability of .01%. Short-time drift is maintained to within a few parts per million.

The "Kay-Lab" chopper stabilizer employs a unique circuit whereby a fraction of the output voltage is compared to a standard cell. A polarized signal of ± 30 volts and 5 ma. is fed to the power supply being regulated, and a precision attenuator is calibrated to provide the desired output voltage to an absolute accuracy of 0.1%.

---

### DIRECTIONAL COUPLER

Whenever a number of television receivers or other pieces of electronic equipment are connected to the same signal source, such as a transmission line, antenna, etc., some means must be used to isolate one piece of equipment or television receiver from the other to prevent interference. The new *SKL* Model 427 directional coupler is designed to provide this necessary isolation between TV receivers in television distribution systems for cities, towns, apartment houses, etc. It may also be used to isolate electronic equipment that must be fed from the same source over the band of 40 to 240 mc.

Model 427 provides one 75-ohm input and two 75-ohm outputs. The directional coupler action results in an insertion loss of 3.2 db and provides an attenuation of reflections and local oscillator interferences originating at a receiver of at least 14 db. For further information, write *Spencer-Kennedy Laboratories, Inc.*, 186 Massachusetts Avenue, Cambridge 39, Mass.

---

### X-RAY SPECTROMETER

Now available from the Research & Control Instruments Division of *North American Philips Company, Inc.*, 750 South Fulton Avenue, Mount Vernon, N. Y., is a Norelco 90° Geiger-counter x-ray spectrometer for use in research and educational fields as well as for production control.

Designed to provide a full standard range of operation, this instrument employs a long-life air-cooled x-ray tube and a goniometer having a radius of 130 mm. Angular range is —10° to +90° (two theta); angles can be read directly from a dial or from a strip chart. The Geiger-counter position is continuously readable to 0.01° (two theta) over the full range.

The high output x-ray generator provides fixed operation at 35 kvp at 6 ma.; it is self-rectified for simplicity and low tube replacement cost. Voltage and current stabilizers are included.

**Photo Credits**

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| | ....................Lear, Inc. |

# AIRBORNE ELECTRONICS CONFERENC

*Highlights of the Dayton Conference, held May 11-13, which was sponsored by the Dayton Section, IRE, and the Professional Group on Airborne Electronics.*

ATTENDANCE at the Fifth Annual Dayton Airborne Electronics Conference exceeded 2000, thus spotlighting the importance of this rapidly expanding branch of the electronics field. There were exhibits by 59 different manufacturers and representatives, and over 100 technical papers were presented.

As the subjects of "mechanized assembly" and "transistors" attracted a great deal of interest at the Conference, this report will concentrate on these two subjects rather than attempt to cover all of the topics which were discussed.

### Mechanized Assembly

Printed circuits of various kinds play a vital role in any mechanized assembly process. E. R. Bowerman, of *Sylvania Electric Products Inc.*, in a paper prepared jointly with Robert F. Walton, discussed a new type of flexible plated circuit with numerous applications. This is a cloth-backed plated circuit, made by a transfer process in which a stripable copper electrodeposit and a thin polyvinyl resist are transferred to a cloth adhesive tape from a stainless steel base. The stainless steel is reusable and its surface may be patterned to identify the wiring on the unit being produced.

Another printed circuit technique, called the Placir process, was described by William J. Weisz, of *Motorola Inc.* In this process, a Bakelite plate is formed, punched as desired, and then roughened. A resist ink is silk-screened onto the area where no circuit is desired, and the remaining surface is treated to make it conductive. Copper is then plated onto this area to the desired thickness of 1 to 3 mils. Plating takes place on the walls of all holes, forming eyelets. Components may be mounted on both sides of the Bakelite sheet, since soldering is accomplished by a touch technique. In effect, a subminiature solder pot is used for each connection. *Motorola* has been using this design for a home radio receiver.

The development of mechanized assembly techniques and machinery has been undertaken by Stanford Research Institute. The current status of this program was reported by Freeman M. Hom and Edwin R. Gamson. Some of this work was described in RADIO-ELECTRONIC ENGINEERING (June, 1953, p. 32) in connection with a report on the Cincinnati Television Conference. Further details were presented on such factors as the type of printed circuit to be used, suitable materials for a resist, dip-soldering techniques, recovery of copper, and means for protecting the final assembly. Although the majority of the work is being done with conventional circuit components, plans are under way for developing components to be used specifically in mechanized assembly processes.

Subminiaturization techniques were discussed by A. H. Drayner, of *Consolidated Vultee Aircraft Corporation*, in a paper prepared jointly with J. R. Allen. A specific project, namely, a servo amplifier, was reviewed in some detail. It was brought out that the use of subminiaturization and printed circuit techniques not only reduces size and weight, but can greatly reduce costs, improve performance, and make servicing easier.

### Transistors

"How the Transistor Changed Our Thinking" was the subject of a paper presented by Ottmar M. Stuetzer, Wright Air Development Center. He emphasized the fact that the engineer must now think in terms of holes, surface potential, diffusion, impurities, etc., and must become familiar with such devices as the hook transistor, tetrode, analog transistor, transstrictor, fieldistor, photodiode, and photomodulator.

A rather startling development was discussed by I. Arnold Lesk, of *General Electric Company*, in a paper entitled "Some Multi-Electrode Germanium Devices." This development is somewhat similar to that utilized in the *Bell Laboratories* "tetrode" junction transistor, but is applied to alloy junctions rather than grown junctions. Mr. Lesk placed one or more alloy junctions on each side of the basic germanium bar, and then polarized the bar by means of a d.c. potential of about four volts. Since the resistance of the germanium was from 1000 to 10,000 ohms, the actual current flowing was rather small. The alloy junctions may be placed opposite each other, or displaced, each location yielding different properties. Thus, it becomes feasible to tailor-make a transistor for practically any desired function.

The paper entitled "Some Applications of Transistors" by L. E. Fl of *Radio Corporation of America*, cited a great deal of interest and ment, partly as the result of demons tions of transistorized equipment. Flory demonstrated a spring-wo phonograph with transistor ampli an all-transistor personal radio, FM receiver, and an auto radio ope ing direct from a 6-volt battery. also demonstrated a power ampl stage having four transistors an 16-ohm speaker as the only compone this amplifier uses two NPN and PNP junction transistors connecte a so-called "complementary" circuit addition, Mr. Flory discussed the us transistor frequency dividers for sweep circuits—an innovation w would greatly simplify camera con circuitry—and a point-contact tran tor which has been made to operat frequencies up to 300 mc., thus ope the way for all-transistor FM and receivers.

An analysis of transistors for amplifiers was presented by Jame Nelson, of *Raytheon Manufactu Company*. He concentrated on the j tion type transistor because it is herently short-circuit stable. Also general, it has lower base and emi resistances and higher collector and tual resistances than the point-con type, these conditions being favor for circuit operation. Mr. Nelson veloped the theory for operation o amplifiers in the 500-kc. range, verified this theory reasonably well perimentally. He found that at the p ent time selection is necessary in o to obtain transistors which will properly as i.f. amplifiers.

Variations in transistor small-si and d.c. parameters were discu very comprehensively by F. M. Du also of *Raytheon*. Mr. Dukat stre the fact that at the present stage o velopment no manufacturing techni are known which can control parameters within close limits o than by selection after manufacture presented a series of curves showing spread for the various characteri based on measurements on 100 produced in the last quarter of This spread has already been red in current production, and is exp to be reduced further as more ex ence is gained.

# Within the INDUSTRY

**JAMES L. BYROM** has been named to the new position of director of engineering for *General Dry Batteries, Inc.* of Cleveland.

The position was created as part of the company's broad program to strengthen its functional organization and to expand all phases of engineering activities in producing a full line of dry-cell batteries for radios, hearing aids, etc.

Mr. Byrom was formerly vice-president and general manager of the *Chandler-Evans Division* of *Niles-Bement-Pond Co.* and prior to that served *Underwood Corp.* and *National Carbon Co.* in engineering capacities.

* * *

**DR. W. R. G. BAKER,** *General Electric Company* vice-president and general manager of its Electronics Division, has been awarded the Medal of Freedom by the Honorable Earl D. Johnson, under-secretary of the Army.

Dr. Baker was awarded the medal for accelerating the application of electronics to the solution of Army research and development problems. He led a mission of leading scientists and industrialists to Korea in the summer of 1952, to study the problem of utilizing electronic devices and principles to the maximum extent in modern war, thereby increasing the effectiveness of the individual soldier and reducing the cost of human life.

* * *

**LEO G. SANDS** has been appointed to the post of sales manager of *Langevin Manufacturing Corporation* of New York.

Mr. Sands recently resigned as president of *Bogue Railway Equipment Division,* manufacturer of railway electrical and communications equipment. He had also served *Bogue Electric Manufacturing Company* as general sales manager.

In his new position, Mr. Sands will make his headquarters at the company's main offices at 37 West 65th Street, New York City.

* * *

**RUSS DIETHERT** of the Chicagoland Chapter was unanimously elected national president of "The Representatives" at the organization's annual delegates' meeting held recently in Chicago. Norman B. Neely of the Los Angeles Chapter was the retiring president.

Wally B. Swank of the Emp State Chapter was named first vi president, Dean A. Lewis of the C fornia Chapter was elected sec vice-president, and Ross Merchant the Wolverine Chapter, third vi president.

Ronald G. Bowen of the Ro Mountain Chapter was elected tional secretary while George Pe of the Chicago Chapter was nan national treasurer.

Mose S. Branum of the Southwe ern Chapter was elected to serve the board of governors for a thr year term.

* * *

**EDWARD L. NUNG,** formerly mana of the Long Island City parts divis plant of *Sylvania,* has been nan manager of the tuner division of *P. Mallory & Co., Inc.* of Indianapolis **DONALD H. KUNSMAN** is the new vi president of the *RCA Service Co pany.* He will be in charge of the c sumer products service division . *CBS-Columbia Inc.* has appoin **LOUIS HAUSMAN** to the post of vi president. The firm is the televis and radio receiver manufacturing s sidiary of the *Columbia Broadcast System, Inc.* . . . **C. J. HARRISON** been named to the newly-created p of marketing manager for the tel sion transmitter division of *Allen Du Mont Laboratories, Inc.* He v supervise field sales activity, order ministration, the division's advertis and publicity program, as well as co dinate all contract processing . . . **WIN I. GUTHMAN,** head of one of largest independent coil manufact ing companies in the country, died cently of a heart attack. He was years old at the time of his death. was the president and founder of *Edwin I. Guthman Co.* of Chicago . *General Electric Company's* tube partment has named **GRADY L. RO** to the post of manager of market with headquarters in Schenectady . **LEONARD L. ROSENFELD** has b named production manager of *Jer Electronic Corporation.* He was merly chief industrial engineer in Joliet, Ill., plant of the *F. W. Sic Division* of *General Instrument C* . . . **WEBSTER E. BARTH** has been pointed general sales manager of *Pointe Electronics Inc.* In his new he will coordinate the sales effort all of the company's divisions.

* * *

**THE MAGNETIC RECORDING INDUS ASSN.** has been recently formed b majority group of the leading recording manufacturers in the U

The meeting to discuss the for

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## UHF "WISHBONE" HIGH DI-ELECTRIC INSULATOR

- EASY TO INSTALL
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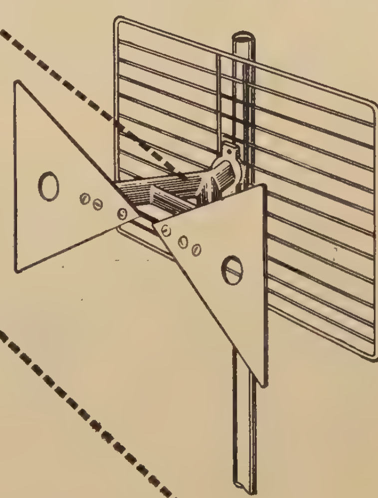

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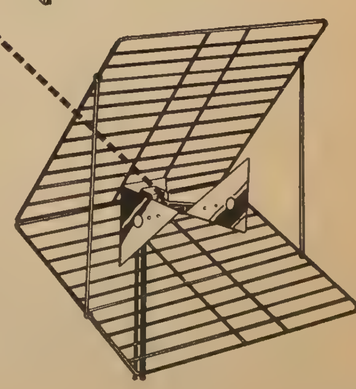
THAT'S RIGHT . . . Only TELCO'S got this remarkable new free air insulator . . . the "Wishbone" . . . that absolutely prevents shorting out under any conditions. Sturdy vibration-proof reflector and rugged aircraft aluminum elements are fastened to the "Wishbone" to prevent vibration and shaky pictures. Antenna performance is proved by actual UHF field testing . . . assures high gain on all channels. Better buy TELCO . . . your all-ways best UHF Antennas!



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called by Joseph F. Hards, vice-p dent of *A-V Tape Libraries Inc.* manufacturers and firms manufa ing related tape recording equip voted unanimously to form the association.

Tape recording manufacturers tending the initial meeting incl *Ampex Electric Corp., Audio De Inc., Bell Sound Systems, Brush tronics Co., Crestwood Recorder sion* of the *Daystrom Electric C Dukane Corporation, Fidelitone, Magnecord Corp., Minnesota M and Manufacturing Co., ORRadi dustries, Inc., The Pentron Corp tion, Webster-Chicago Corp., Webster Electric Co.*

Mr. Hards was elected presi *pro-tem.* An organizing committee been appointed to outline the purp and functions, and to draw up th laws of the association.

* * *

**EUGENE F. PETERSON** has been pointed manager of marketing *General Electric Company's* radio and television department.

He was formerly manager of marketing for the company's tube department with headquarters in Schenectady. He will now be loc at the Electronics Park plant in S cuse.

Upon graduation from college, after serving a year as a professo physics at Sterling College, Mr. P son joined the *G-E* test enginee program in 1933. He joined the Department in 1934 and compl the company's advanced course in gineering in 1936.

He has served in various engin ing and supervisory capacities at company's Schenectady and Ow boro, Ky. plants. He was named r ager of marketing for the department in 1951.

* * *

**MILWAUKEE SCHOOL OF ENGINEE** recently celebrated its 50th anni sary with a banquet attended by s and civic dignitaries.

Founded in 1903 by Oscar Werw the school has grown until toda has an annual enrollment of 1500 time and 350 evening students. N ly 50,000 students have received t ing at the school since 1903.

Karl Werwath, son of the foun assumed the presidency upon his ther's death in 1948. Another Heinz M. is controller and treasu

* * *

**MOTOROLA, INC.** of Chicago is rently celebrating its 25th yea the electronics field.

Founded in 1928 as *Galvin Manu turing Company* by Paul V. Ga the firm had six employees an capital fund of $565. The comp now *Motorola, Inc.*, has since g

(*Continued on page* 105)

# FILM FOR TV

By
HENRY J. SEITZ, S.M.P.T.E.

*As production costs continue to spiral, more and more of your favorite TV programs will come to you on film.*

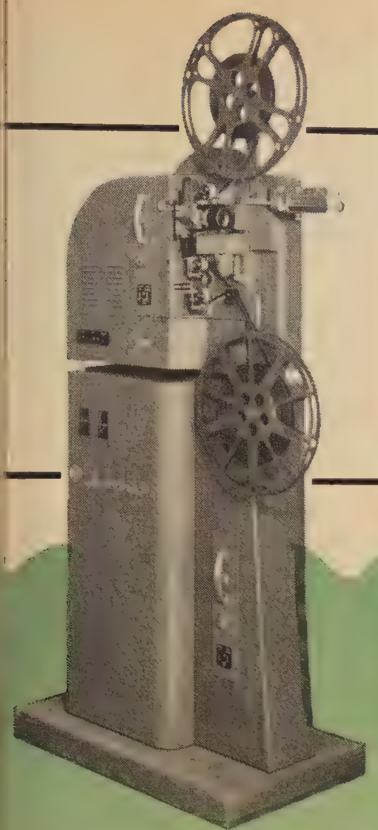


Fig. 1. Over-all view of the 16 mm television film projector designed and built by Radio Corp. of America.

T IS an obvious conclusion that mo-
tion picture films are destined to
play an increasingly important role
the future of television. To effec-
vely demonstrate their products at
wer cost and at the same time main-
in standards comparable to live
udio pick-up, alert business execu-
ves are turning towards the medium
film advertisement.

An ever increasing footage of com-
ercial film flows daily out of proc-
ssing laboratories. Kinescope record-
gs in New York City alone, accord-
g to a well-known trade publication,
ach 2,000,000 feet per week. The
chniques of laboratory quality con-
ol are most rigid wherever television
directly concerned.

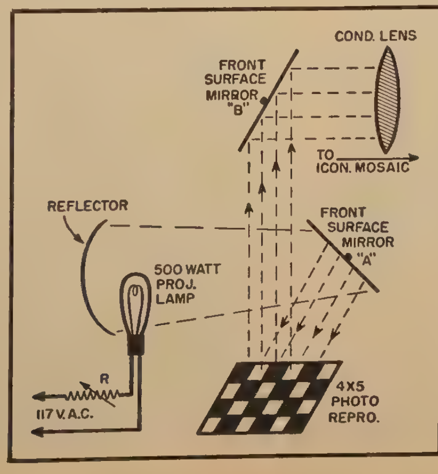
Today phrases like "gamma," "print
nsity" and "tonal gradation" ap-
ar in conversation with TV broad-
st engineers. It would seem that a
eeping technical revolution is slowly
rking place, wherein tomorrow's
chnician must not only be well
rsed in electronics but in the art of
otography as well. Some of the
rger advertising agencies, as a mat-
r of fact, employ skilled consultants
hose job is to integrate the medium
film to that of television.

In lieu of moving pictures, adver-
sers will often employ pictorial stills
"telops" as they are sometimes
lled. (Fig. 2) These may be similar
standard 4x5 photo reproductions.
other cases a slide transparency
ay be used. Various effects such as
ssolves, superimpositions, and even emergency transmission of the TV station's test pattern can be achieved by using either of these devices. A dissolve-to-black, for instance, may be obtained by slowly cutting off the 500-watt lamp filament supply. (See Fig. 2)

Kinescope recording or the filming of moving pictures from the face of a special CRT offers unlimited horizons. In effect it conveniently satisfies the U.S. time zone differences. A hit show that begins at 8:00 p.m. New York time will hardly be acceptable to Californians, where it is only five o'clock in the afternoon. By kinescoping the live show and presenting it over the station's film facilities later in the evening, the sponsor's product is thereby advertised to a West Coast audience.

As an effective transducer for converting film images into their electrical equivalent, the iconoscope (Fig. 3) is presently among the most popular. Its grey scale response has a curve that closely approximates that of the average home television receiver. Furthermore film camera control operators favor the "Ike" because video gain riding is reduced to two major operating controls, namely, gain and pedestal. (Fig. 9)

Fig. 2. How the "telop" device is used to transmit static images in television work.




In this fashion shading problems are reduced to a minimum and necessary critical adjustments can be performed quickly and effectively. Except for ordinary routine maintenance, the iconoscope requires little attention once it has been correctly aligned.

Modern innovations like edge- and back-lighting, have reduced to a minimum certain drawbacks that were prevalent when iconoscopes were first employed. Many old time viewers will undoubtedly recall the anguish experienced whenever their celluloid hero disappeared into the flare at the viewing tube's edge, only to emerge later showered by secondary electrons. In those days the "Ghost Rider" really lived up to his name.

Before proceeding any further, certain basic characteristics of film might well be investigated. For example, an outdoor scene may register a brightness contrast (the ratio between the brightest and darkest values) of 150 to 1 or higher between the bluish light of the sky and the darkest of shadows. The human optical mechanism accounts for an adaptation of about 100 to 1. A theater-type motion picture projector is capable of yielding a screen brightness of 40 to 1. With home TV receivers approximating only 25 to 1, it can readily be seen that film quality is of paramount importance.

To effectively reproduce a good grey scale or tonal gradation between the highlights and shadows, print density should conform to certain basic standards. This, in turn, depends upon a sequence of factors that may well include (*a*) the photographic negative original; (b) laboratory processing, and (*c*) the final printing. Whether 16 or 35 mm, if the release or final print is able to reproduce many delicate shades of grey, it is called "low contrast" film.

On the other hand, films of "high contrast" (contrasty) are extremely black and white. Having little or no grey scale, the end result is a rather harsh picture and one lacking in fine detail. The measure of contrast is in-

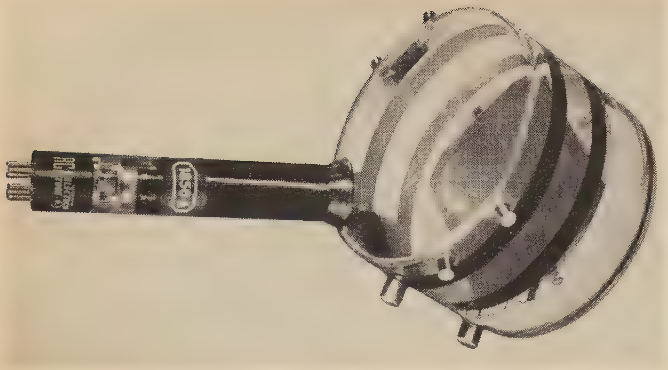


Fig. 3. Over-all view of RCA's Type 1850A iconoscope tube.

Fig. 4. RCA's 5WP11 transcriber kinescope for TV film work.

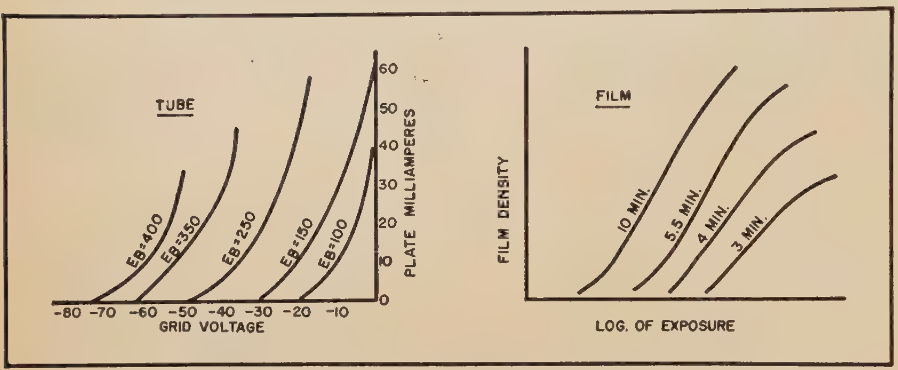



Fig. 5. Demonstrating the similarity between tube and film characteristic curves.

dicated by the letter $\gamma$ (gamma) of the Greek alphabet.

Film also possesses its own series of characteristic curves remarkably similar to those of vacuum tubes with which we are all familiar. (Fig. 5) However, instead of $E_g$, $E_b$ being the determinant factors, sensitometry makes use of the relationship between the two variables, exposure and density. Since tubes fall into specialized groups (sharp cut-off, high mu, etc.) it conveniently follows that many types of film stock having countless variations (coarse grain, fine grain, slow speed) are also obtainable.

It can readily be seen that any decrease in light transmission caused by dense or contrasty film, will tend to limit iconoscope action to the lower portion of its own characteristic curve. (Fig. 11) Consequently flare, graininess, and noise have a tendency to b accentuated. Noise acts to preven the transmission of higher frequen cies, so necessary to a sharp, snapp picture.

Obviously the best means of over coming noise is to maintain a hig signal-to-noise ratio. In the *RCA* un preamplifier special attention is give to the critical film camera inpu stage. A *Western Electric* 417A dua miniature triode is used. The trans conductance ($G_m$) of this amazin little tube is about 25,000. If we re member our musty classroom text ordinary run-of-the-mill triodes fa within a range of only 200 to 500 micromhos!

This tube, when used as a cascode type input feeding a 6J6 outpu (Fig. 8), vastly enhances iconoscop performance. The over-all gain about three times that of the earlie 6AK5 which was 8. The heater opera tion is d.c. In addition, low inductanc bypass condensers are inserted in th filament circuits. Sixty-cycle problem are thereby eliminated.

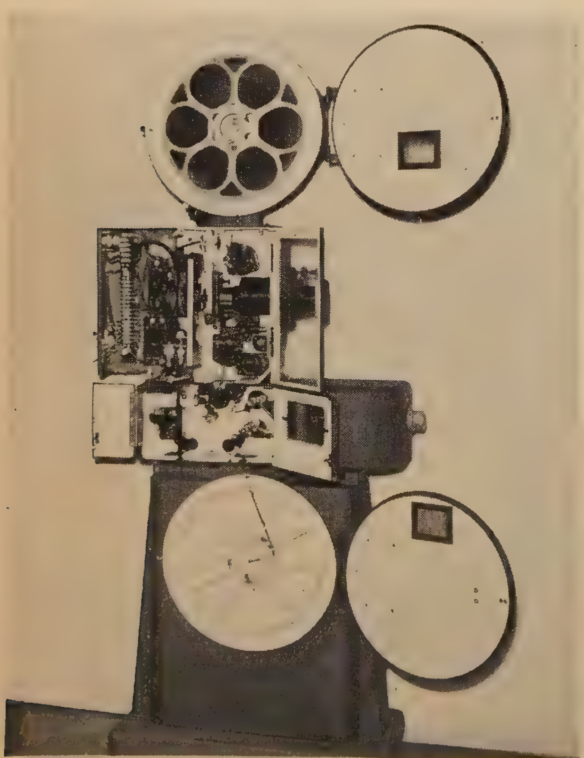
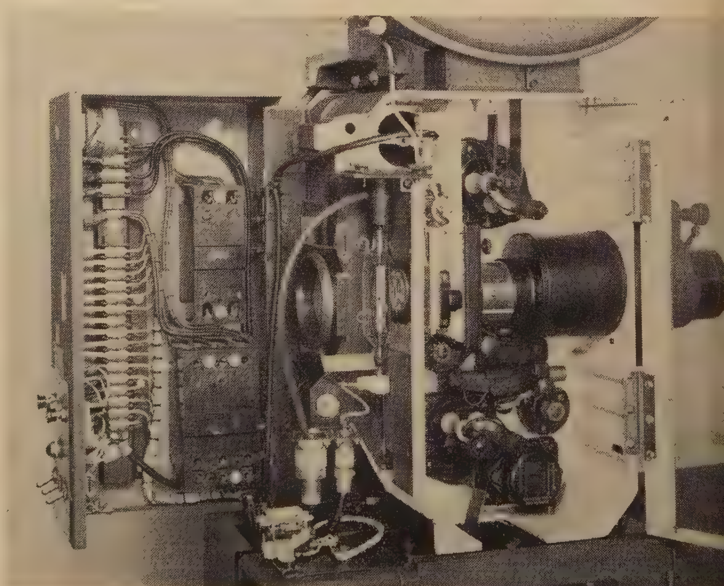
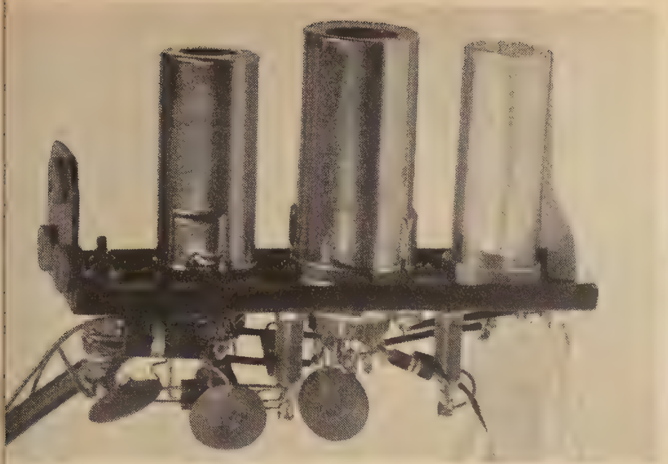


Fig. 6. Radio Corporation of America's TP-35B 35 mm television film projector unit. The intermittent is a three-sided Geneva movement driven by a specially-designed synchronous motor.

Fig. 7. One of the newer type pulsed light film projectors mad by RCA. This machine eliminates the need for a shutter and available in both 16 and 35 mm sizes for television film wor





ġ. 8. Cascode preamp using the W.E. 417A (the middle tube).

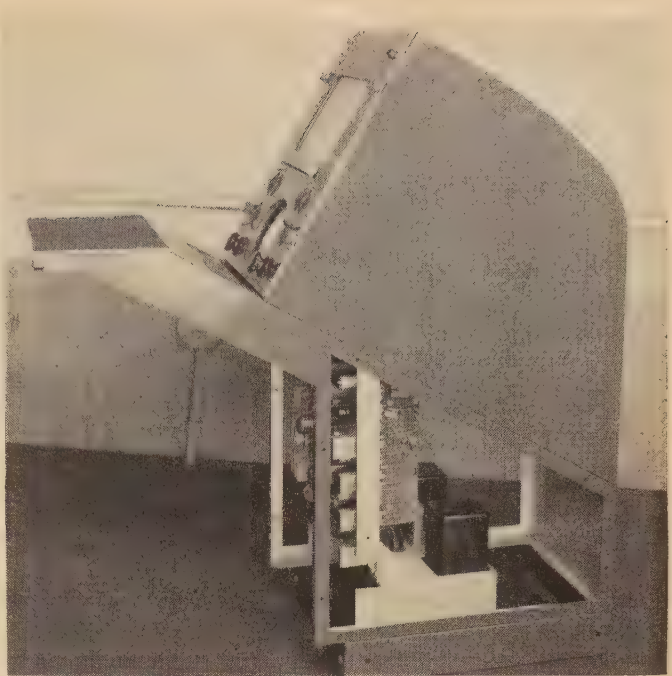


Fig. 9. RCA's new TK-20A film camera control which consists of a console desk section with a control chassis mounted in lower compartment and camera monitor mounted in upper part. A picture amplifier fed by the preamp in the camera, pulse line amplifiers which feed driving signals from the studio sync generator to the camera and monitor, shading signal generators, and several associated camera controls are included in chassis.

Since no subject is more frequently isunderstood, the conversion of mov-g picture film rate to conform to levision standards requires some ex-lanation. Fortunately a standardized rojection rate of 24 frames or pic-ures-per-second holds for both the 6 and 35 mm systems.

In most 16 mm systems (Fig. 10), ne projected light illuminating the lm is momentarily interrupted by a otched rotary disc called the shut-er. This permits the projector's film ulldown mechanism to operate while ne screen is dark. Since the next uccessive film frame now rests in the lm aperture, the intense light beam ill easily pass through it whenever ne notch and beam coincide.

In effect, each frame is projected ither two or three times. However, ince the entire action takes place in uch a rapid sequence, (7.2 inches-er-second for 16 mm) the eye is ricked into believing that it sees a ontinuous motion of fast moving mages.

Since the frame rate for television is 60 fields interlaced to produce 30 omplete pictures-per-second, some neans must be utilized to compensate or existing frame differences. Stand-rd projection rates, as it was pre-iously mentioned, consist of 24 rames-per-second. We have, there-ore, a ratio of 5 to 4 to satisfy. In ther words two frames of motion picture film will require the same mount of time as five TV fields or .5 TV frames. Therefore by flashing nd scanning one film frame twice nd the other three times, the dif-erence in frame rate is conveniently atisfied.

Moving pictures consist of a series aken at a 24 frame-per-second rate. Each frame pauses a fraction of a econd while being exposed. Converse-y, the same principle applies in pro-ection. Television film projectors, on he other hand, employ an intermittent movement. Film advancing mechanisms in the latter type are categorized as 2 to 3 intermittents.

In the *RCA* TP-35B (Fig. 6) the intermittent is a three-sided Geneva movement driven by a synchronous motor. This pulls the film down at unequal time intervals (2:3). Thus a combination of mechanical motion plus iconoscope storage and scanning synthesize to produce television moving pictures—a tribute to engineering ingenuity.

In a typical TV 16 mm system, (Fig. 1), a rotary shutter synchronized at 3600 rpm interrupts the projected light 60 times per second. The shutter is so designed that each flash lasts 1/1200th of a second. By accurately timing these flashes and causing them to fall within the system's vertical blanking period of 1270 microseconds, we impress upon the iconoscope's mosaic information which is then scanned and converted into a video signal.

As will be seen from Fig. 12 these intense bursts of light occur only before or after pulldown. In effect this prevents "travel ghost," a most unpleasant phenomenon, caused by nonsynchronous action in the projector's shutter operation. The newer type of pulsed-light machine eliminates the need for a shutter and is available in both the 16 and 35 mm sizes (Fig. 7).

These light flashes coming from the projection lamp must at all times coincide or "lock-in" with the system's vertical blanking interval. Accurate synchronism is maintained by using a common source of a.c. for both the TV station's sync generator and the film projector motors. In addition synchronous type motors are used throughout.

Television recording or the transcribing of images by photographic means sounds complex, however when reduced to its basic fundamentals it practically amounts to no more than a reversal of preceding film techniques. Instead of 24 film frames being converted to 30 pictures-per-second we now work backwards to convert 30 TV pictures to 24 film frames.

The cathode-ray tube, a 5WP11, from which the pictures are taken is one of high resolution and short persistence (Fig. 4). In comparison

(*Continued on page* 130)

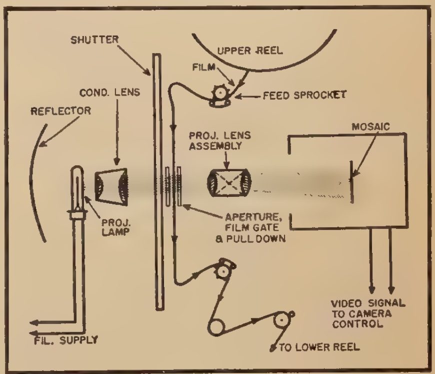
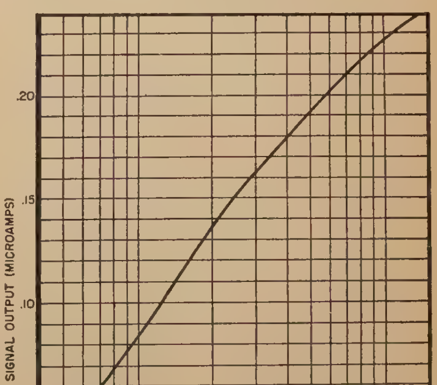
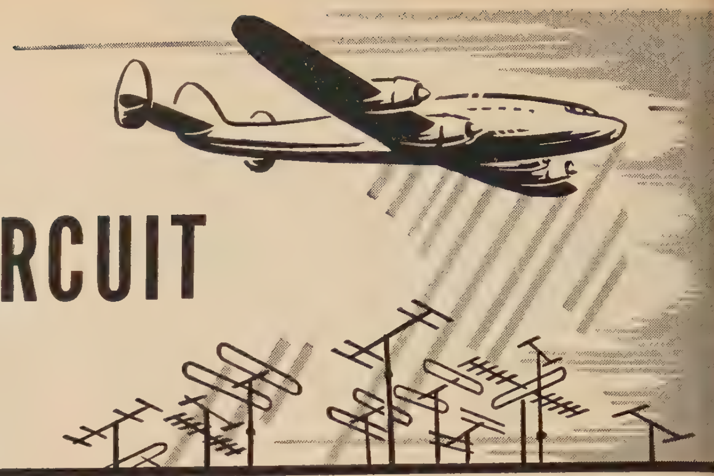



Fig. 10. Typical 16 mm TV-type film projector.

Fig. 11. Iconoscope characteristic curve (1850A).





# A SIMPLE ANTI-FLUTTER CIRCUIT

By **JOHN K. FRIEBORN**

*This simple British TV circuit may be used in U.S. receivers to eliminate airplane picture flutter.*

MANY television set-owners have no idea what the effects of airplane flutter look like. A few, who live near airports, hardly know what a television picture would look like without these effects — unless their receivers contain some circuit to reduce them. Most recent American television receivers incorporate automatic gain control circuits which are "keyed" specifically to reduce one of the effects of airplane flutter. Keyed a.g.c. circuits are relatively complex; they require the addition of one tube and several other components to the receiver. Recent 21-inch *HMV* (British) television receivers use a simpler circuit which accomplishes about the same thing.[1] The fact that the circuit and several related ones are covered by a 1951 British patent[2] may or may not account for the fact that nothing of the sort seems to have been used by any American manufacturer in place of a keyed a.g.c. circuit.

Airplane flutter is the name given to the combination of effects on the television picture when a signal reflected from a moving aircraft is combined in the receiver with the direct signal from the station. There are two main effects: first, a "ghost" picture is produced and second, there is a fluctuation in the over-all average brightness of the screen. By using an extremely directional antenna, both effects can be reduced, unless the aircraft is nearly the same direction from the receiver as the transmitter. If a sufficiently directional antenna is impractical, appropriate receiver circuits can at least reduce the amount of brightness fluctuation.

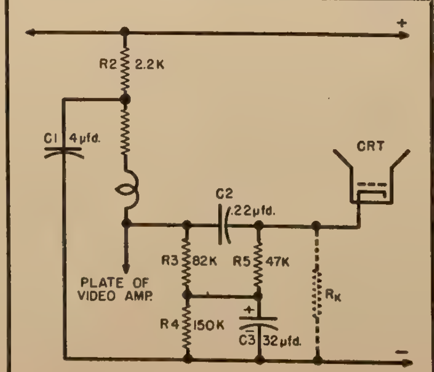
A reflected signal may be in-phase with the direct signal and add to it or out-of-phase and subtract from it. The exact phase relation will depend upon the difference between the times taken by the signal to travel over the direct and reflected paths. If the time difference is exactly enough to allow the r.f. signal to complete a whole number of cycles, the two signals will be in-phase, although they may have slightly different instantaneous modulations. The modulation of the reflected signal, which travels for the longer time, corresponds to an earlier part of each line in the original picture. Therefore, the modulation corresponding to a certain point on the original scene appears later (that is, farther to the right) in the ghost image than in the direct signal image. If the time difference between the two paths is exactly enough to allow a whole number of cycles of the r.f. signal and one-half cycle more, then the signals are out-of-phase and the resultant is generally (neglecting difference in modulation) less than the amplitude of the direct signal alone.

If the signal is reflected from a moving object, such as an airplane, the combined amplitude is increased, decreased, and then increased again, possibly several times. This variation in signal strength results in a variation in the brightness of the reproduced picture on any receiver which can follow these changes in the d.c. component of the video signal. The frequency of the brightness fluctuations depends upon the speed of the aircraft, its position and direction of flight with respect to the transmitter and receiver, and the frequency of the r.f. carrier. A typical range of frequencies under different conditions and on different v.h.f. television channels is from 0.1 to 40 cycles-per-second. The most rapid variations are masked by the persistence of the picture tube phosphor and persistence of vision of the eye, while the slowest variations are not particularly objectionable. The frequency range of objectionable fluctuations may be from approximately 0.5 to 10 cycles-per-second.

Since the fluctuations in brightness are caused by variations in signal strength, one obvious solution to the problem is to keep the signal strength constant by means of an automatic gain control circuit. It should be noted that it is the peak amplitude of the signal which is kept constant by an ideal a.g.c. circuit, so that variations in the average signal strength due to variations in the average brightness of the original scene are reproduced at the receiver. Compensation for such rapid variations in signal strength as those caused by airplane flutter requires a short time constant in the automatic gain control circuit. However, the shorter the time constant in the a.g.c. circuit, other things being equal, the more the circuit is affected by noise. One method of reducing the effect of noise while retaining the short time constant is to key the a.g.c. circuit on for short periods of time and key it off for long periods in between. A keyed a.g.c. circuit is, of course, affected only by the noise which occurs during the small fraction of the total time when it is keyed on. Keyed a.g.c. is an effective solution to the problem of airplane flutter (or at least to the brightness-fluctuation part of the problem), but it *is* complicated.

A different approach to the problem is based on the fact that the fluctuations in brightness are, in effect, spurious video signals of very low fre

Fig. 1. Partial schematic of the British HMV 21-inch receiver showing the anti-flutter circuit described in the text.



encies. One simple way to elimi-te these very low video frequen-cies is by using capacitive coupling in the video amplifier and omitting d.c. restoration. This method has two re-lated disadvantages: first, the aver-age brightness is the same for every scene, regardless of what it was origi-nally and second, with the average brightness constant, the blanking level varies, so that additional blank-ing circuits are necessary to keep the retrace lines from becoming visible occasionally.

The method used in the *HMV* re-ceiver mentioned at the beginning of this article reduces the d.c. component about 50%, but it reduces the am-plitude of the most objectionable flut-ter frequencies much more. A partial schematic diagram of the receiver is shown in Fig. 1. This circuit provides a boost of extremely low-frequency and d.c. components of the video sig-nal in the plate circuit of the video amplifier, by means of $R_2$ and $C_1$, then two separate paths for the video sig-nal from the video amplifier plate to the picture tube cathode. The a.c. components of the signal (frequen-cies from 50 cycles up, under the British standards) are transmitted through $C_3$ without much loss. The d.c. component is boosted almost 50% by $C_1$, then applied through $R_3$, $R_4$, and $R_5$, to $R_k$, the cathode input resistance of the picture tube. The net transmis-sion is said to be about 55%, which would mean a value for $R_k$ of about 10,000 ohms. At one cycle-per-sec-ond, the transmission *via* both paths is reduced so that the combined trans-mission is only about 9%. The over-all transmission characteristic is ap-proximately as shown in Fig. 2. This graph shows that the attenuation is considerable over the entire band of frequencies involved in airplane flut-ter.

A theoretical disadvantage of the circuit of Fig. 1 is that very rapid changes in the average brightness of the original scene would not be real-istically reproduced, but such rapid changes hardly ever occur. Probably most people living near airports would be willing to sacrifice perfect repro-duction of an occasional lightning flash on a television program in order to have a simple method of reducing airplane flutter.

Many American television receivers which do not have keyed a.g.c. could be modified to incorporate anti-flutter circuits of this type. Several obser-vations can be made which would save some "cut-and-try" time for ex-perimenters wishing to make such modifications.

First, since the circuit is basically a bandstop filter, it may be thought that circuits such as the Wien bridge, the bridged-T, or the parallel-T would be better, since they give al-most no output at all at their null fre-quencies, whereas the original cir-cuit does transmit 9%. The greater attenuation might be desirable, but these circuits have bandwidths less than the one in Fig. 1, so that they may not be effective over as wide a range of flutter frequencies. Also, they require more components.

Second, the original circuit was found to be satisfactory in a receiver tuned to the London television chan-nel, a frequency of less than 50 mega-cycles. The highest American v.h.f. channel being more than four times as high in frequency, American receivers could be subject to flutter frequen-cies more than four times as high as those for which the original circuit was found to be effective. The best compromise for all of our channels probably would be obtained with a time constant approximately twice as high as the original, that is, a fre-quency of maximum attenuation of about two cycles-per-second, instead of one.

Third, it may be desirable to trans-mit the d.c. component without the 45% loss. This can be done by in-creasing the values of $R_2$ and $R_4$ in Fig. 1. The limit of increasing $R_4$ would be to make it infinite (that is, an open circuit—omit it altogether). We would still have some resistance effectively in parallel with $C_3$, the leakage resistance of the condenser, which would reduce the d.c. component of the video signal slightly.

Fourth, if the anti-flutter circuit is used in a receiver which has d.c. re-insertion, it must follow the d.c. re-inserter; otherwise, the d.c. re-inserter will cancel out the effect of the anti-flutter circuit. This fact makes it a bit difficult to use the circuit in re-ceivers which have any type of d.c. re-insertion except that based on video amplifier grid-leak bias.

Fifth, the effects of the resistors in the network on the d.c. potentials on the picture tube must be taken into account and compensated for if neces-sary.

Sixth, the values of the components must be suitable to the impedance level at the point in the receiver where the circuit is to be inserted.

Seventh, the wiring must be care-fully done in such a way as to add a minimum of shunt capacitance to the video circuit, as excessive added capacitance would disturb the original high-frequency compensation.

Two typical examples of receivers which can be modified to include this anti-flutter circuit without too much difficulty are shown in Figs. 3 and 4. The component values given in the modified circuits are tentative and may have to be adjusted in a partic-ular receiver to restore the original picture tube potentials or to give maximum reduction of the flutter fre-quency which is found most trouble-some in a particular location.

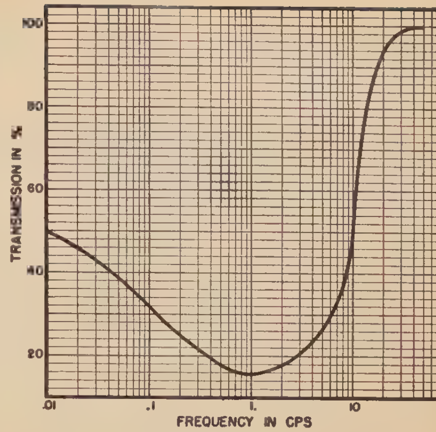



**Fig. 2. Low-frequency transmission characteristic of the circuit in Fig. 1.**

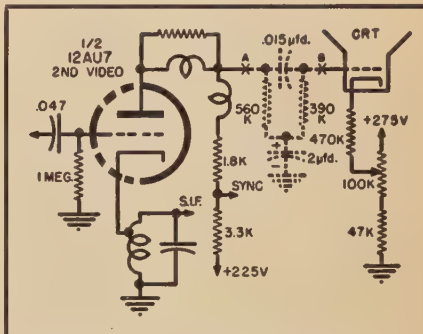


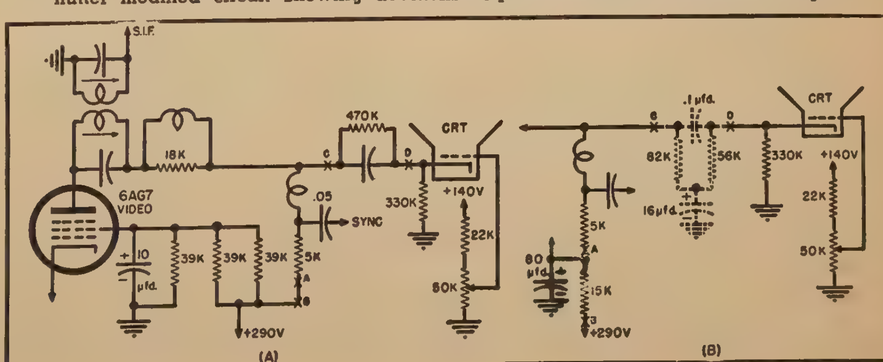

**Fig. 3. Partial schematic of the Majestic Series 106 TV receiver showing (dotted) the modification to eliminate flutter.**

The *Majestic* Series 106 TV re-ceivers use a diode a.g.c. circuit, grid-leak bias d.c. re-insertion, and grid drive to the picture tube. Modification of this circuit consists simply of in-serting the new components between the peaking coils and the grid of the picture tube, see Fig. 3, paying at-tention to the caution about wiring capacitance given previously.

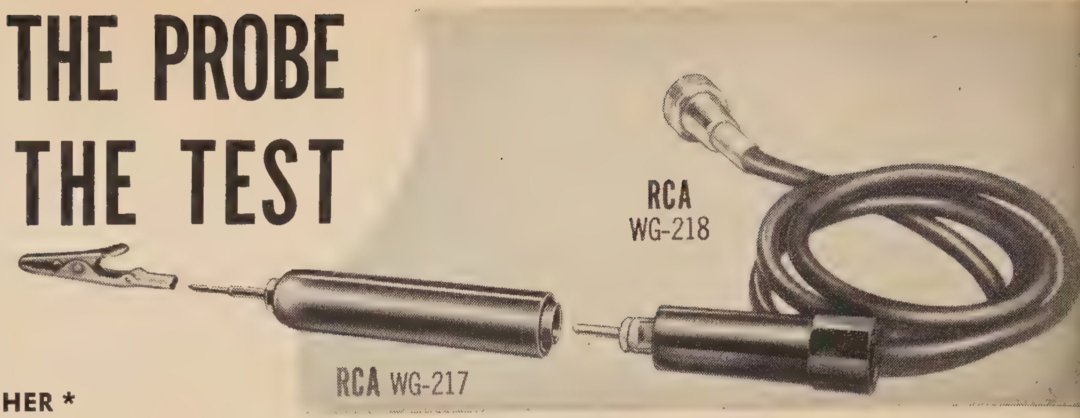
*Fada* TV receiver Model S7C20 uses

(*Continued on page* 78)

**Fig. 4. (A) Original video circuit of the Fada Model S7C20 TV receiver. (B) Anti-flutter modified circuit showing additions required to maintain circuit voltages.**



# CHOOSE THE PROBE TO FIT THE TEST




By
**ART LIEBSCHER ***

(Left) The RCA WG-217 isolating probe for d.c. voltage measurements. (Right) Direct WG-218 unit which is used for low-frequency a.c. voltage measurement.

*The scope or v.t.v.m. probe you select will affect the test results obtained. Here are pointers on choosing the right one.*

IN THE servicing of modern electronic devices, accuracy of measurement is the prime requisite for fast, positive analysis of circuit performance.

Under ideal circumstances, a test instrument would measure the full voltage in any electronic circuit. The instrument would have infinite input resistance and zero shunt capacitance; therefore, it would not cause any detuning, produce any alteration of waveform, nor develop any other detriment to normal operation of the circuit being tested.

From a practical viewpoint, however, it is well recognized that the contact of any measuring device has its immediate effects on the operation of an electronic circuit. Depending on the type of circuit being tested, the actual degree of this effect may vary from negligible shunting to susceptibility to the very approach of a test prod.

While some small amount of power from the circuit must be shared with the resistive input of the testing facilities, those facilities which hold power-sampling requirements to a minimum consistent with stability and accuracy most nearly approach the "ideal." Where high-frequency circuits are concerned, the detuning caused by test prod and cable capacitance is often more serious than the resistive loading problem. Together, these problems so complicate the measurement of electronic circuits as to require complete departure from the use of low-impedance, unshielded test instruments with open-wire test leads. Coping with any one problem leads to a train of problems, each of which must be fully solved to insure accurate and stable readings.

Resistive loading can be minimized by the use of high-impedance electronic measuring instruments. The circuits in such instruments, however, are not normally designed to discriminate between all of the desired and undesired potentials to which they are subjected. Therefore, they must be shielded from extraneous electrostatic and electromagnetic fields which would introduce hum, noise, and other unwanted interference. For this reason, the majority of vacuum-tube voltmeters and oscilloscopes are equipped with metal cases. But the problem of shielding does not end with the case alone, for there must be an electrical link between the point of circuit measurement and the test instrument. This link, in the form of a test lead, must also be shielded. If the test lead is viewed as an extension of the electronic measuring circuit contained in a shielded test-instrument case, the logic of shielding the test lead right up to the tip of the test prod becomes obvious.

Unshielded test leads are sometimes responsible for obscure effects which hinder measurement accuracy. A test lead often acts as an antenna in picking up the signal from one circuit and re-radiating it to another circuit in the device being tested. In this way cross-coupling is established between normally shielded sections of a receiver or other electronic device, even to the extent that regeneration or oscillation occurs.

Although test-lead shielding serves to exclude interference, it increases circuit loading at high frequencies because the capacitance of the shielded wire lowers the effective input impedance of the measuring instrument. However, the capacitance added by the shielded lead is fixed and remains unchanged irrespective of the position or movement of the lead.

The effect of added capacitance can be removed and the smaller loading effect characteristic of open-wire test leads restored through the use of a low-capacitance test probe in conjunction with the shielded lead. The reduction in capacitance, however, is accompanied by a loss in signal voltage entering the test instrument. Low-capacitance probes, therefore, are designed to increase the input resistance of the test instrument. When th[e] signal loss in the probe is regaine[d] by amplification in the test instru[-]ment, the desired qualities of hig[h] input impedance, freedom from inter[-]ference, and minimum circuit loadin[g] are obtained.

* Formerly Test Equipment Specialist, Tube Dept., Radio Corporation of America, Camden, New Jersey

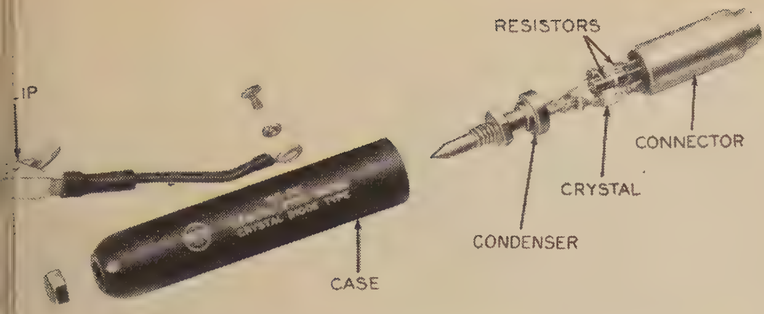
Probes, originally used as test proc[ds] and intended for convenience in han[-]dling the ends of flexible test lead[s] have now become housings for variou[s] circuit components. These component[s] are often required at the point of tes[t] contact for least disturbance to th[e] circuit and for maximum efficiency i[n] supplying measurable currents throug[h] the test cable to the instrument. In[-]put specifications for test instrument[s] should, therefore, be specified *at th[e] probe,* if they are to represent th[e] true conditions of test applicatio[n]. Panel input terminal specification[s] are meaningless where test cable[s] must be added to make use of an in[-]strument, for it is as impractical t[o] do without the cable as it is to hol[d] the entire instrument against the ci[r]cuit being tested.

While many electronic test instru[-]ments are now equipped with shielde[d] cables, only a few have input cable[s] which are designed for use with [a] number of different probes. The *RC[A]* WG-218 direct probe and cable accom[-]modates four varieties of slip-on probe[s] which are now available. Having a[s]sorted and quickly interchangeab[le] probes is like acquiring additional in[-]struments.

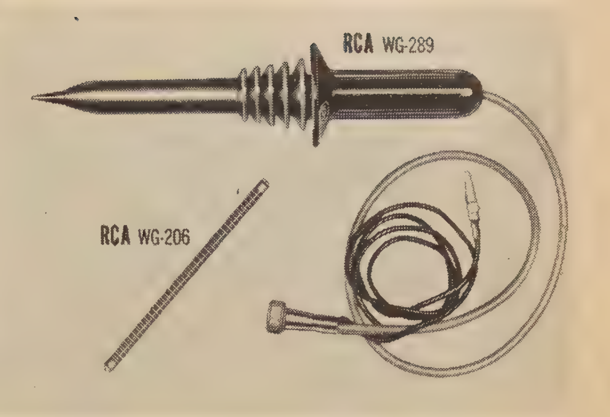
In order to become familiar with th[e] application of various types of probe[s] now commercially available, it is we[ll] to consider them first by function[al] classification. The major classification[s] are: direct probes, low-capacitan[ce] probes, isolating probes, rectifyin[g] probes, and multiplying probes.

## Direct Probes

The *RCA* WG-218 direct probe a[nd]




he RCA Model WG-291 demodulator probe of the crystal diode type. ee text for details on the various circuit applications for this probe.




WG-289 high-voltage probe with auxiliary WG-206 unit. Latter unit is added to probe to provide required voltage division.

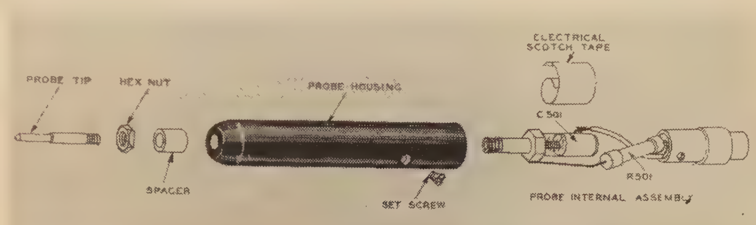
able is a "straight-through" connec-on-type test probe attached to a ingle-lead shielded cable. It possesses e normal electrical characteristics f the cable itself. This probe and ssociated cable have been standard-ed for use with *RCA* oscilloscopes nd "VoltOhmysts," their principal pplication being for the transfer of ectrical information from a circuit or slip-on probe) to the input con-ector on the instrument. When used ith *RCA* "VoltOhmysts" and oscillo-copes, this cable provides an over-all put capacitance of approximately 80 fd. Because the maximum frequency ange of the cable-and-instrument ombination varies inversely with the npedance of the voltage source, it is npractical to state one maximum requency limit. In general, all low-equency voltages, even those with omplex waveforms, can be measured n both low-impedance and high-im-edance circuits. Accurate measure-ent at higher frequencies is limited o lower-impedance circuits.

The direct probe and cable cannot e used in the accurate measurement f voltages of complex waves or pulses aving considerable high-frequency ontent because cable-capacitance oading acts to reduce those voltages. eans for reducing or eliminating the ffects of this input capacitance will e discussed in connection with the ollowing probes, most of which are esigned for use in conjunction with e WG-218 direct probe and cable.

## Low-Capacitance Probes

The use of a small condenser in an scilloscope probe, connected in series ith the capacitance of the shielded est lead, provides a voltage divider aving very small input capacitance. his is typified by adding an *RCA* VG-216B low-capacitance probe to the irect probe and cable.

The normal capacitance of a direct robe and cable may be about 70 to 00 $\mu\mu$fd. With selected resistance and apacitance combinations the input apacitance of a low-capacitance probe an be held to a value below 10 $\mu\mu$fd. ow-capacitance input, however, is not btained without some sacrifice of in-ut signal level, because this type of




"Exploded" view of RCA WG-216B probe showing the various component parts.

probe is a voltage divider. The inherent loss in the WG-216B probe is fixed at a factor of 10 for convenience in calculating the attenuating effect when the probe is used with a calibrated instrument. Because the attenuation factor must be applied at low frequencies as well as high, the probe must be frequency-compensated for a wide response range.

Where the normal resistance of an oscilloscope is on the order of one megohm, and the small input condenser in a low-capacitance probe is shunted by a high value of resistance, the total series input resistance can be raised to 10 megohms. The combined resist-

WG-264 rectifying probe disassembled to show the various component parts.

Table 1. Quick reference chart for selecting proper probe for the job at hand.

| MEASUREMENT | CLASSIFICATION | RCA TYPE | LOADING FACTOR | VOLTAGE LIMITATIONS |
|---|---|---|---|---|
| D.C. Voltage (V.T.V.M.) | Isolating | WG-217 | 11 megohms* | 1500 v. d.c. max. |
| High-Voltage D.C.<br>Low-Frequency A.C. | Multiplying<br>Direct | WG-289<br>WG-218 | 1100 megohms*<br>70 $\mu\mu$fd., 1 megohm* | 50 kv. d.c. max.<br>1500 v. r.m.s.; 4200 v. peak-to-peak sine wave* |
| High-Frequency A.C. or Complex Wave | Low-Capacitance | WG-216B | 9 $\mu\mu$fd., 10 megohms | 2000 v. peak-to-peak; 500 v. d.c.* |
| Rectified R.F. or A.C. | Rectifying | WG-264 | 1.75 $\mu\mu$fd., 6000 ohms at 200 mc.** | 20 v. r.m.s., 28 v. peak; 250 v. d.c. |
| Modulated R.F. | Rectifying and Demodulating | WG-291 | 2.25 $\mu\mu$fd., 2500 ohms at 200 mc.** | 20 v. r.m.s., 28 v. peak; 250 v. d.c. |

* Approximate values which vary with instrument
** Approximate values which vary with frequency

ance divider and capacitance divider form an *RC* divider having both flat frequency response and minimum circuit-loading characteristics.

The WG-216B probe input condenser is adjustable and it is made accessible by unscrewing the contact tip. This condenser is adjusted by the manufacturer to obtain best square-wave response.

The WG-216B probe is designed for use with *RCA* WO-56, WO-57, and WO-88 series oscilloscopes. Its voltage input ratings are consistent with the input ratings of these instruments.

The two-fold purpose of a low-capacitance probe is to reduce the capacitive and resistive loading effect on the circuit being tested and to pass all frequency components in the circuit to the test instrument. The use of such a probe can in no way extend the frequency response of the test instrument. Some distorted waveforms seen on an oscilloscope, therefore, are unimproved by the addition of a low-capacitance probe. The full value of the probe can only be realized when the response of the instrument is not the limiting factor.

The low-capacitance probe used in conjunction with an oscilloscope gives that instrument a marked advantage which is readily observed when it is desired to examine the waveform in a sensitive circuit as, for example, a television horizontal oscillator. With a probe that does not have low capacitance, the waveform will change its slope and the picture will usually tear out when the oscillator is detuned by application of the probe. With the low-capacitance probe, the waveform will have a straight horizontal appearance between start and finish peaks and the TV picture is not likely to tear out during probe contact.

## Isolating Probes

The *RCA* WG-217 d.c. probe is fitted with a one-megohm resistor in its housing to isolate the circuit under test from the test instrument and cable and to keep high-frequency a.c. out of the vacuum-tube voltmeter with which it is used.

When this probe is applied to the grid of an i.f. amplifier, for example, the distributed capacitance across the one-megohm isolating resistor is the only path for high-frequency loss. Because that capacitance is negligible, no discernible detuning problem exists. Although the value of the resistor is too high to pass any appreciable high frequency, it results in perfect combination with the high internal 10-megohm input resistance of the "VoltOhmyst" for indication of d.c. grid bias. The total resistance of 11 megohms is great enough to allow bias reading without serious loading error.

When it is desired to read a.c. from a source which also contains d.c., a blocking condenser is necessary. This condenser may be located either in the probe or in the test instrument. Good low-frequency response requires the use of a fairly large condenser and it is normally found in the instrument simply because it would be too cumbersome to house in a probe.

## Rectifying Probes

The primary function of a rectifying probe is to extend the high-frequency range of a test instrument. Used at the point of test contact, such a probe performs the function of a detector and delivers rectified output voltage proportional to the r.f. input voltage being detected. Because of the usual sine-wave composition of high-frequency voltages, rectifying probes are generally of the half-wave type capable of developing either r.m.s. voltages for vacuum tube voltmeter measurements or peak voltages for oscilloscope indication.

Depending upon whether the probe is to be used with a voltmeter or oscilloscope, its output circuit has a long or short time constant. A probe designed for use with a vacuum tube voltmeter delivers filtered d.c. output proportional to the amplitude of the r.f. wave. A probe designed for use with an oscilloscope delivers d.c. output which fluctuates according to the amplitude modulation of the r.f. wave.

Because the circuitry differs with the output requirements of rectifying probes, it is necessary to have special probes for particular applications. The two most popular types, therefore, are described separately in the following paragraphs.

## Crystal Diode Probes

The *RCA* WG-264 crystal diode probe contains a germanium crystal diode which, by proximity to the point of test, produces rectified output with a minimum of signal loss. It is a half-wave rectifier of the peak-reading type and develops a d.c. output which is indicated as a negative d.c. voltage across the input resistance of a "VoltOhmyst." The probe is calibrated for use with "VoltOhmysts" so that the measured d.c. output is equivalent to the r.m.s. value of the sine-wave voltage at the input of the probe.

When intermediate-frequency to v.h.f. signals are measured, r.m.s. voltage readings are normally sufficient. The measurement of video and sync signals in peak-to-peak values is not a function of the WG-264 type of probe. These values are better measured with a direct probe and a peak-to-peak reading vacuum tube voltmeter such as the *RCA* WV-97A "Senior VoltOhmyst."

The WG-264 crystal diode probe has an input frequency range from 50 kc to 250 mc. and an input capacitance of 1.75 μμfd. Its input voltage ratings are sufficient for applications in the r.f. and i.f. sections of TV sets and other low-level electronic devices.

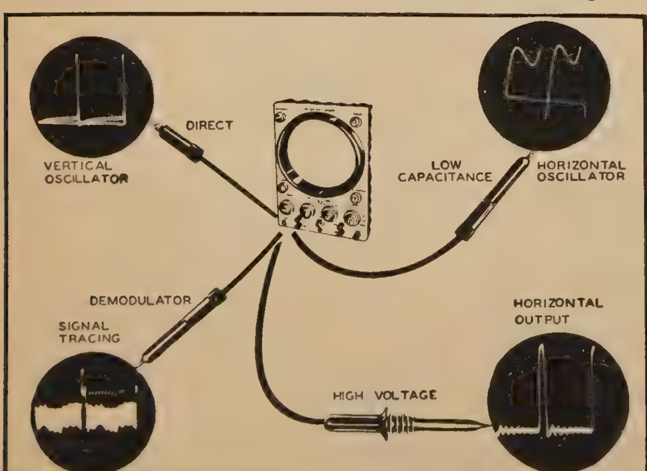
When quantitative measurement of r.f. (and i.f.) is the sole consideration the crystal diode probe is excellent for checking stage gain, tracing signals, locating spurious oscillations, and detecting and measuring r.f. output from oscillators and signal generators.

## Demodulator Probes

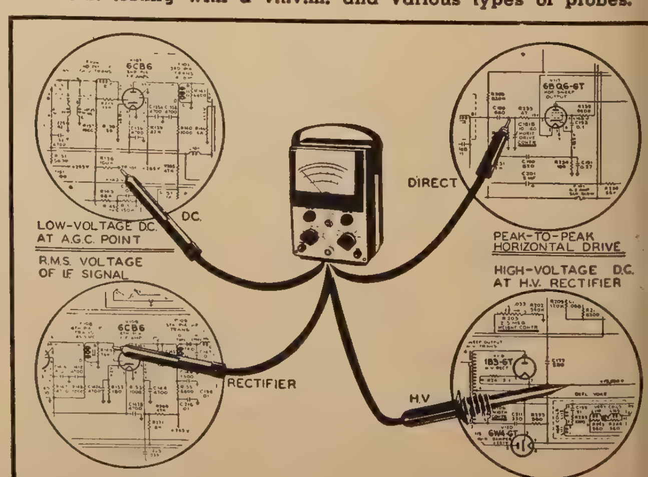
Another in the family of crystal diode rectifier probes, the demodulator probe *RCA* WG-291 serves to perform certain functions beyond the basic requirement of furnishing d.c. output. Although the demodulator probe will rectify r.f. input and produce d.c. equivalent to the peak value of the input voltage, it differs from the WG-264 in that it is not calibrated an

(*Continued on page* 132)

**Applications of probes used in conjunction with oscilloscope.**

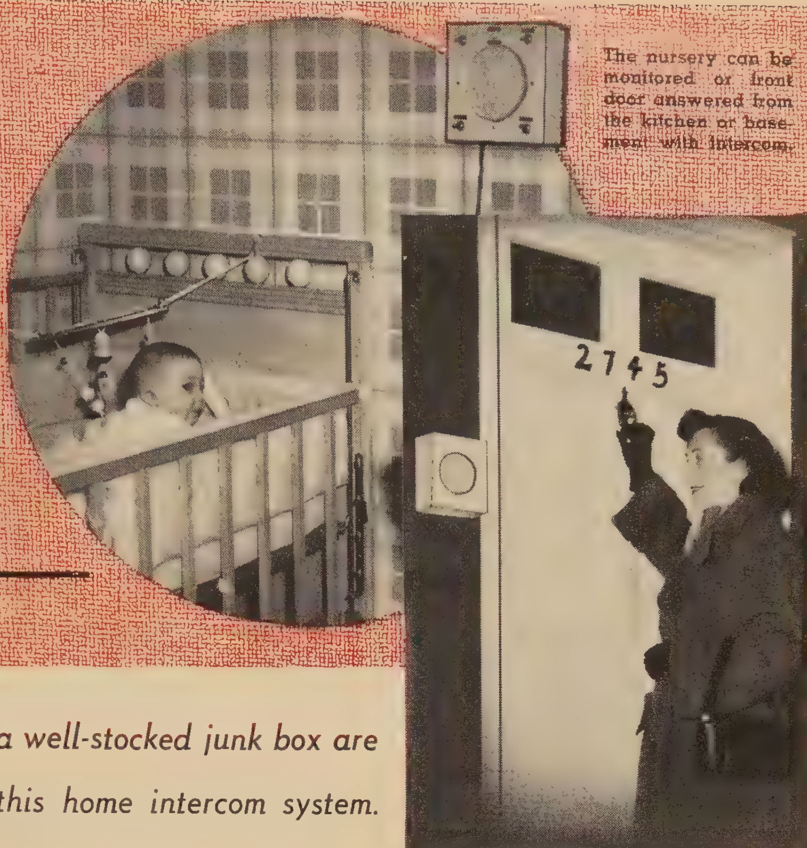



**Circuit testing with a v.t.v.m. and various types of probes.**



# ELECTRONIC "BUTLER AND BABYSITTER"

By SIDNEY LIPMAN




The nursery can be monitored or front door answered from the kitchen or basement with Intercom.

*ew cents a month for power and a well-stocked junk box are*
*d only requirements for building this home intercom system.*

.Y intercom for the home must .e inexpensive to build and to perate and must be useful enough arrant the cost. As the name im- d the two most important func- of the system to be described are ering the door and keeping in with the "King" or "Queen" in ursery. Initial cost, if every item ught new, and the junk box can provide any help, will be about dollars and the running costs are t as much as running an electric —a few cents a month.

e installation described consists ree master stations and one slave on, all powered from the same ifier. Additional stations may be d or some of the stations elimi- d, depending upon the require- ts of the individual home, without ing the efficiency of the system. use of the very low power re- ments, the author runs the am- r continuously day and night and a number of months of opera- not a single component, including s and rectifier, has overheated. e amplifier is a high-gain, three- unit built on a standard 5 x 7 nch deep aluminum chassis. The s selected require less than three s for heater power and the ium rectifier power supply re- s about the same wattage. To nt shocks from the amplifier sis, a polarized plug was used sure that the chassis is always at nd potential. If a polarized plug socket are not available, only the side of the line should be con- d to one prong of the plug and hassis connected to a water pipe ground by a single wire. In the event the plug is not inserted properly the heaters will not light up when the switch is turned on and it will only be necessary to turn the plug over to obtain proper operation.

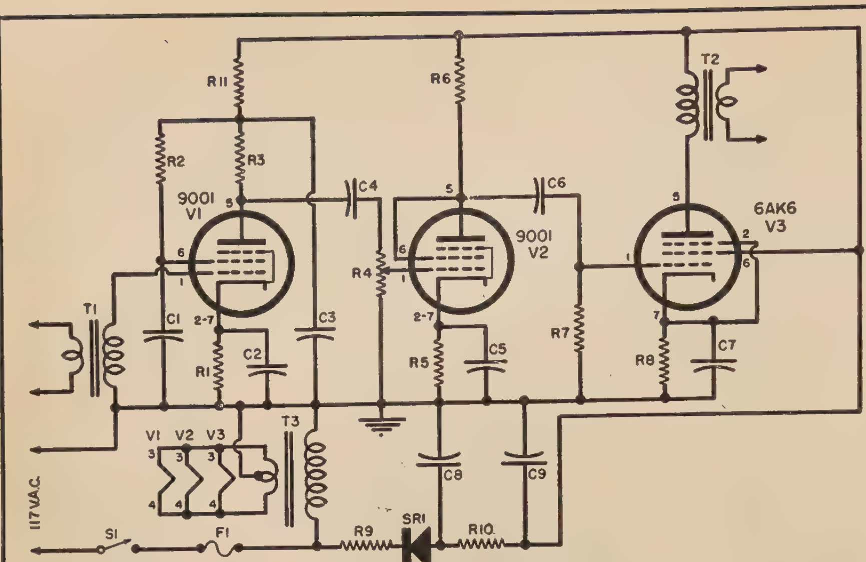
In the amplifier shown in the photographs a number of the resistors pictured are of greater wattage than those specified in the diagram. This is because the unit was built from junk box parts. All values shown on the diagram are for minimum wattages but no harm can be done by using a resistor of a higher wattage rating if it is more readily available. The electrolytic condensers, in some cases, are of a larger capacity and higher voltage rating than those called for in the diagram. Again the diagram values should be taken as minimum values and higher capacity or voltage ratings may be substituted if more readily available.

The biggest problem to overcome is hum pickup. The amplifier pictured uses the point-to-point wiring technique to minimize hum, with a single row of tie points to support the ground and voltage supply ends of the resistors. The decoupling and screen dropping resistors are mounted on the tie point strip. The power supply components are all arranged at one end of the chassis and the signal components at the other. On top of the chassis are placed the filament transformer and the output transformer. The heater pins of the tubes (pins 3 and 4 in all cases) face the power end of the chassis. Two leads are run to the heaters and the center tap of the transformer is grounded, to minimize hum. The transformer mounted on the edge of the chassis is the input transformer and was mounted in this spot to—you guessed it—reduce hum. It is a standard output transformer.

The input to the amplifier uses a shielded lead with the hot wire connecting to one end of the input transformer voice coil winding at the two-terminal board and the shield connecting to the other voice coil lead. The output from the amplifier is handled in the same manner. No connection is made to the chassis and the shields are connected together only at the central terminal board mounted centrally in the cellar on a ceiling beam. The amplifier is located on a storage shelf a few inches away from the terminal board.

Each station is wired to a barrier strip connection block, and crimp-on lugs are used on all leads. This eliminates the necessity for chasing all over the house with a soldering iron and simplifies troubleshooting or the addition of more stations. Provision was made for a fifth station which will probably remain unused until a garage is built.

The station in the nursery is located between the crib and the bathinette and the pickup is sensitive enough to allow the smallest whimper to be heard. If someone rings the doorbell while baby is being bathed, the controls are within easy reach of Mother to tell the visitor to "return later" or "wait a moment" or "we do not want any." After interviewing half a dozen storm window salesmen, Mother found it gratifying to be



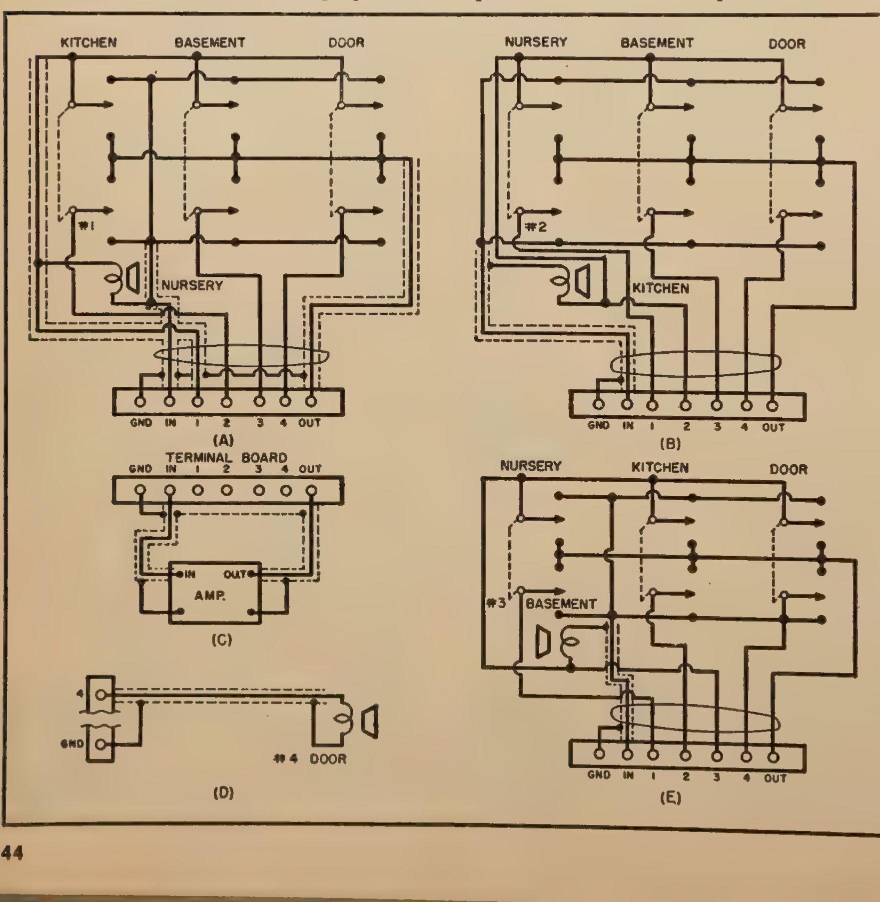

*$R_1$, $R_5$—1000 ohm, ½ w. res.*
*$R_2$, $R_3$—100,000 ohm, ½ w. res.*
*$R_4$—1 megohm pot.*
*$R_6$, $R_{11}$—47,000 ohm, ½ w. res.*
*$R_7$—470,000 ohm, ½ w. res.*
*$R_8$—470 ohm, 1 w. res.*
*$R_9$—47 ohm, ½ w. res.*
*$R_{10}$—1000 ohm, 2 w. res.*
*$C_1$—.1 μfd., 400 v. cond.*
*$C_2$, $C_5$, $C_7$—4 μfd., 25 v. elec. cond.*
*$C_3$—4 μfd., 150 v. elec. cond.*
*$C_4$, $C_6$—.01 μfd., 400 v. cond.*
*$C_8$, $C_9$—8 μfd., 150 v. elec. cond.*
*$S_1$—S.p.s.t. switch*
*$F_1$—1 amp. line fuse*
*$T_1$, $T_2$—Output trans. 5000 ohms to 6 ohm v.c.*
*$T_3$—Fil. trans., 6.3 v. @ 1 amp.*
*$SR_1$—65 ma. selenium rectifier*
*$V_1$, $V_2$—9001 tube*
*$V_3$—6AK6 tube*

**Complete schematic of intercom station. Any number of units can be used in system.**

able to send the others away without subjecting baby to a draught in the middle of her bath.

The master stations are equipped with a separate double-pole, double-throw, center-off switch for each other station. The switches of all stations are normally left in the center-*off* position. When a call is to be initiated, the switch for the station being called is put in the "up" position and the message delivered from any distance away from the speaker, up to four feet or more. The switch is then pushed to the "down" position to hear the answer. When the con-

**Different methods for hooking up intercom system. See text for complete details.**




versation is over the switch is turned to the middle position. person at the station being ca need do nothing more than ans the question put to him from point in the room being called.

When the lady of the house is in the kitchen, which is a good of the day, she is but a step a from the baby's room at the far of the house *via* the speaker mou over her work space. When suppe ready it requires only a softly spo word with the basement switch in "up" position to bring Father up f his various hobbies. A special need not be spoiled by having to left alone at a critical moment order to answer the front door w a few well chosen words into "Butler" will keep the *Fuller Br* salesman on the front porch until crisis is past.

The kitchen station is mounted der the metal cabinets with self-t ping screws. There is a double tom to the cabinets so the screws not extend through. The leads run conspicuously along the bottom of cabinets, down the edge of the tile through a small hole in the floor hind the refrigerator. The statio the nursery is mounted against wall with wood screws that go thro screw eyes screwed along the and bottom of the cabinet. The ca runs down the wall and along baseboard until it snakes its down a hole in the corner of the r under the crib. Standard insula staples are used for holding cable.

The front door speaker was trea with *Walltex* before being insta in the cabinet. This is a material waterproofs the cone and is desig for treating wall paper to make washable. It has a wax base. the speaker cabinets were home-m of 3/16" plywood and painted to ma the walls upon which they mounted. The front door and kitc units are painted white and the r sery unit is a cream color. After paint is dry a thick coat of pa wax, such as *Johnson's* floor wax applied. This makes the cabinets e to clean as well as making th waterproof.

All speakers are protected by piece of copper window screen wit piece of an old sheet in front of The holes for the speakers were in the plywood with a fly cutter fore the cabinets were assembled. cutting half way through from e side, a neat hole is produced. cabinets are butt joined and gl with *Stanley* glue. In addition a small nails, similar to those foun cigar boxes, were used to hold pieces together until the glue dr

The cables running from the var stations to the central terminal bo are run along the rafters. A sm hole through the wood shingles wh they meet the concrete founda was used to bring the single shie lead into the cellar from the f

station. The wires were strung at a time and were held in place nishing nails crossed with about arter-inch spacing between the nails. Wires can be installed by ting them at right angles to their nal position, putting them be- n the heads of the nails and then ng up the slack, which puts the under both nails. This system vs more wires to be added any

e shields of the cable going to the ery are grounded to a water pipe convenient spot. There should be one ground in the cable of all stations. If a ground wire is used return of the amplifier chassis it ld be separate and go to the near- cold water pipe. The basement on, which is not illustrated, is slightly differently. The switches alling other stations were mounted n inch and a half strip of alu- m which is screwed along the of the work bench. The speaker a three foot wire on it so it can et at any convenient spot on the h, or on the floor when a big is undertaken. There were no s convenient to hang the speaker The first installation was a di- line from the nursery to the ment and was responsible for the or having a chance to complete other stations while Mother was The slightest whimper brought er up armed with bottle, safety and so on. Another labor sav- convenience is the ability to tell door-to-door salesmen "we do not t any" without running up the s and halfway through the house pen the door.

me trouble may be encountered ny of the cables exceed twenty in length. Oscillation may occur to coupling between input and ut circuits. If the wires in the can be spaced an inch or more each other, this will not occur. oler, but more expensive is ded wire. The author found ssary to shield only one cable, going to the nursery. Three wires all that must be shielded: The t, output, and the wire that is ected directly to the speaker of distant station. The author found nvenient to run a single shielded to all stations for the input cir- in order to minimize hum pick- rom those stations not used dur- a particular conversation. The ld is also used as a return, sav- wire. If possible, color coded should be used to simplify servic- If this is not convenient, tag the s so that, at a later date, you will v which is which.

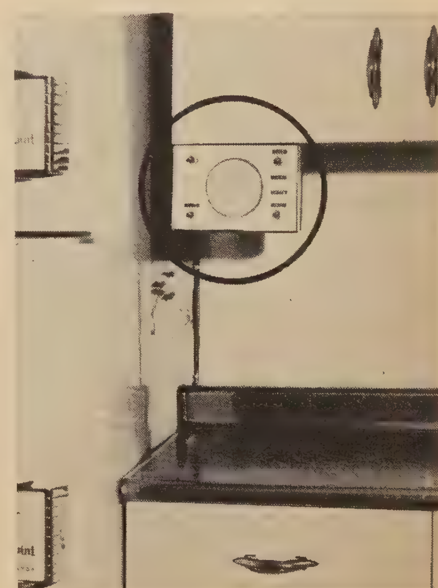
s in a railroad telegraph system, worst offense an operator can mit is to leave a switch in the ng position. However; with this em all is not lost as is the case the telegraph. If, for instance, her has left her switch for the ment station in the "down" or en" position and Father puts his

A station unit. Any cabinet appropriate to decorative scheme may be employed.

switch in the basement to the kitchen "talk" position, oscillations will be reproduced at the two stations. This will indicate to Mother that she left her switch in the wrong position and that it should be returned to its neutral position since someone is trying to call her. It also indicates to Father in the basement that his message was not received.

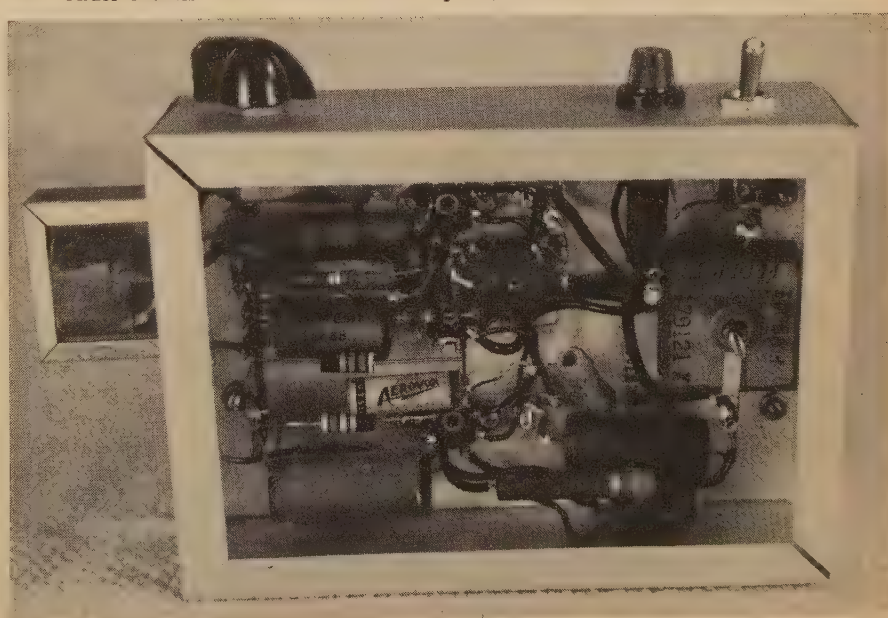
While the author claims no startling innovations for this set-up, this intercom system works well, is virtually foolproof, costs little to build, and even less to operate—all desirable features for any home intercom installation to have. In addition, it is easy to build and install.

In the few months that the electronic "Butler and Babysitter" have been working for the family, untold numbers of steps have been saved. It has also been gratifying to know that Mother need not answer the door when alone in the house without first knowing "Who's calling please?" —30—

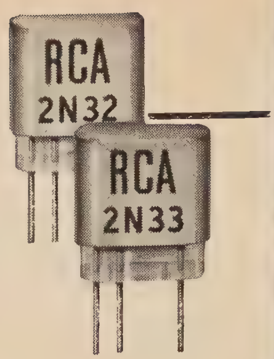


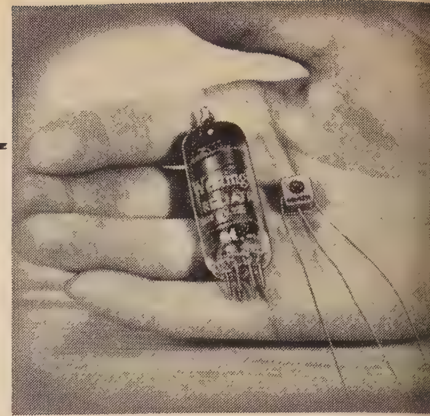
Kitchen intercom mounted on metal cabinet.

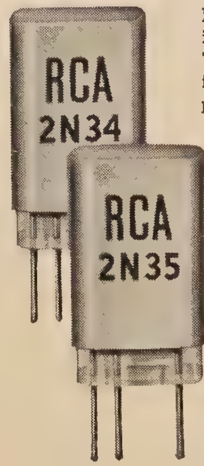
Under chassis view of station. This layout prevents overheating of components.



# TRANSISTOR PHYSICS *Simplified*






RCA's 2N32 point-contact type designed for large-signal pulse or s ing operations. The 2N33 for oscillator applications in 50 mc. r The 2N34, a "p-n-p" junction type audio amplifier for low-power frequency applications. RCA's 2N35, an "n-p-n" junction type audi plifier for low-power, low-frequency use. (Above) Westinghouse's WX

By

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*Part 2. Concluding article covers point contact type transistors, their design, construction, and circuit applications.*

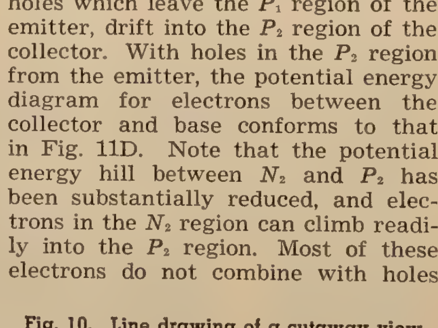
IT WAS pointed out in the previous article (July) that in a junction transistor the emitter, base, and collector connections to the crystal are low-resistance (large area) connections. In the point-contact transistor the emitter and the collector connections to the crystal are point-contact (relatively high-resistance, small area) connections. Fig 10 is a line drawing cut-away view of the transistor. The base connection, however, is a low-resistance (large area) connection. It was mentioned in previous paragraphs that the emitter current is slightly larger than the collector current in the junction transistor and that the base current is extremely small. It has been found by experiment that in the point-contact transistor the collector current (unlike the collector current of the junction transistor) is substantially larger than the emitter current, and that the base current is relatively large. In the following paragraphs an attempt will be made to explain these differences between the junction transistor and the point-contact transistor.

Although the point-contact transistor employs what is considered to be either an $n$-type germanium crystal or a $p$-type germanium only, experimental investigation has shown that in the $n$-type point-contact transistor, $p$-type layers occur, and that in the $p$-type contact transistor, $n$-type layers occur. Fig. 11A shows an $n$-type point-contact transistor. It is seen that under the emitter point is a very thin layer of $p$-type germanium ($P_1$), and under the collector point is a thin layer of $n$-type germanium ($N_2$), followed by a thin layer of $p$-type germanium ($P_2$). By observation it can be seen that the emitter-base section is biased in the forward direction. Current flow consisting mainly of holes in the $P_1$-type germanium and mainly of electrons in the $N_1$-type germanium will occur. However, an increase in emitter current causes a large increase in collector current and a decrease in emitter current causes a large decrease in collector current. The following paragraph will attempt to explain the current amplification of the transistor. Fig. 11B is an enlarged view of the collector-base circuit. The potential energy diagram for electrons in the crystal portion of this circuit is shown in Fig. 11C. Under steady-state conditions (no signal applied), very few electrons climb the potential energy hill between $N_2$ and $P_2$. However, those that do climb the hill do not combine with the holes in the $P_2$ region because it is a thin region. These electrons fall quickly down the potential hill between $P_2$ and $N_1$. When the emitter-base region conducts, some of the holes which leave the $P_1$ region of the emitter, drift into the $P_2$ region of the collector. With holes in the $P_2$ region from the emitter, the potential energy diagram for electrons between the collector and base conforms to that in Fig. 11D. Note that the potential energy hill between $N_2$ and $P_2$ has been substantially reduced, and electrons in the $N_2$ region can climb readily into the $P_2$ region. Most of these electrons do not combine with holes in this region, but fall very ra into the $N_2$ (base) region. For hole that enters the $P_2$ region the $P_1$ region, many electrons flow the $N_2$ region through the $P_2$ r down into the $N_1$ region. Thus, seen that large current amplific may be effected. This amplific of current is expressed as $\alpha$ (al and is equivalent to mu (the vo amplification factor of a vac tube). Mathematically, $\alpha = \Delta I$ where $\Delta I_c$ equals a small chang collector current, and $\Delta I_e$ a s change in emitter current.

Point-contact transistors have made with $p$-type germanium a main body. The theory explainin operation of this type point-co transistor is similar to that exp ing the operation of the $n$-type p contact transistor. The differenc course, is that the main current rier consists of holes instead of trons. The explanation in the pre paragraph coupled with the info tion in Fig. 12 will enable the r to understand the theory of oper of $p$-type point-contact transi Note that the polarities for the ter with respect to the base, an collector with respect to the base of necessity, been changed.

The operation of a point-co transistor can be compared to operation of a triode vacuum The emitter is equivalent to the the base to the cathode, and th lector to the plate. The base cu is relatively large, and the majo

Fig. 10. Line drawing of a cutaway view of a transistor of the point-contact type.



of it goes to the collector. Unlike rid of a vacuum tube, the emit-raws a continuous current. The (emitter) impedance is low and output (collector) impedance is . In a vacuum tube the input ) impedance is high and the out-plate) impedance is low. For a arison of transistors and vacuum see Tables 1 and 2.

## Bias Voltages

a vacuum tube the grid is usu-biased negatively with respect to athode, and the plate is made ive with respect to the cathode. the transistor the collector may ositive or negative with respect e base, and the emitter may be ve or negative with respect to ase. These are illustrated in Fig. The bias polarities depend on her the transistor is an *n-p-n* or junction type, or a *p* or *n* point-ct type. To simplify the problem he technician, the diagrams of 13 have been prepared, which ate bias polarities required for arious types of transistors. If one mbers that the *n*-type point-con-transistor is, by stretching the nation a bit, actually, a *p-n-p* transistor, and the *p*-type tran-, is an *n-p-n* transistor, bias ities can be remembered easily he following simple rule. The er is biased in a foward direction respect to the base and the col- is biased in the reverse direc-with respect to the base, in any istor.

## Conclusion

ese articles have presented in y descriptive, non-mathematical the fairly complicated physics ansistors. Although this type of ment is inadequate for those in-ted in a quantitative presentation, oped that the average radio-tele-n technician will have a greater rstanding and appreciation of circuits employing transistors in lace of vacuum tubes. It may be ioned here briefly that major dif-ces occur in transistor circuits ared with the corresponding vac-tube circuits. This is a study in and since this article was de-d to be merely an introduction e large number of transistor cir-which will make their appear-on the radio-television horizon, tempt has been made to discuss fic circuitry.

ny articles have been written the theory of transistor physics; ver, these articles explained ly the mathematical concepts, s a result, to coin a phrase, "did it home" as far as the technician ngineer who is not directly con-d with transistor application. In article the authors have at-ted to provide the theoretical ication for a different method of ical transistor physics presen-n.

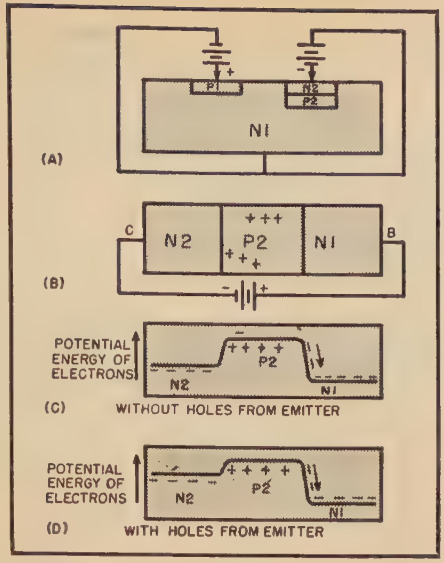



**Fig. 11. An "n" type point-contact type of transistor. See text for complete details.**

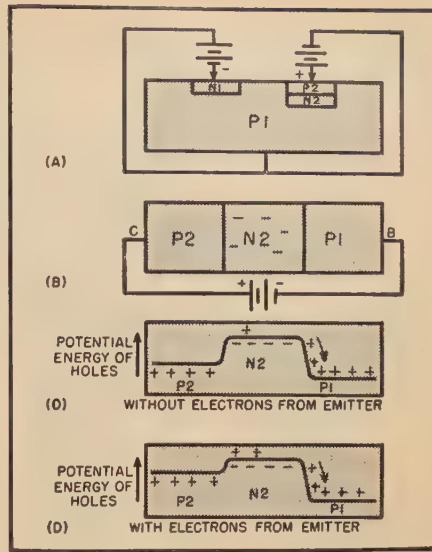



**Fig. 12. A "p" type point-contact transistor. Note differences from Fig. 11, left.**

| VACUUM TUBE | TRANSISTOR |
|---|---|
| Cathode | Emitter |
| Plate | Collector |
| Grid | Base |
| $\mu = \Delta E_p/\Delta E_g$ | $\alpha = \Delta I_c/\Delta I_e$ |
| Voltage Amp. | Current Amp. |
| High Input Imp. (grounded cathode) | High Input Imp. (grounded emitter) |
| Low Output Imp. | Low Output Imp. |
| High Power Consumption | Low Power Consumption |
| Fragile | Rugged |
| Large in Size | Small in Size |

**Table 1. Comparison of characteristics between vacuum tube and a junction transistor.**

| VACUUM TUBE | TRANSISTOR |
|---|---|
| Cathode | Base |
| Grid | Emitter |
| Plate | Collector |
| Voltage Amp. | Current Amp. |
| $\mu = \Delta E_p/\Delta E_g$ | $\alpha = \Delta I_c/\Delta I_e$ |
| High Input Imp. | Low Input Imp. |
| Low Output Imp. | High Output Imp. |
| $I_p$ | $E_c$ |
| $E_p$ | $I_c$ |
| $I_g$ | $E_e$ |
| $E_g$ | $I_e$ |
| Constant E Supply | Constant I Supply |
| Capacitance | Inductance |
| Large in Size | Small in Size |
| High Power Consumption | Low Power Consumption |
| Fragile to Shock | Rugged |
| Reverse Bias | Forward Bias |

**Table 2. Comparison between point-contact type transistor and standard vacuum tube.**

Although the transistor is only five years old, much is expected of it in the near future. Many electronic units will be freed from the vacuum tube's limitations, namely, fragility, bulkiness, and short life. To think that in such a short time since its inception, the combined production of transistor makers has resulted in an output of 50,000 units a month. Before the end of 1953, output is expected to exceed 250,000 units a month. Is it any wonder that they call transistors the miracle of the Twentieth Century?

From the outset of radio it has been known that semiconductors, such as galena, have the ability to rectify alternating current signals. In fact, the "cat whisker" galena crystal was a standard part of the early radio set. But the fundamental reason why some substances conduct and others do not had to be investigated by some of our leading physicists before the transistor became a reality.

Transistors have been introduced successfully in such units as the phono amplifier, radio and television receiver, hearing aid, "walkie-talkie" set, radar spotting device, computer, and other devices which employ, at present, vacuum tubes. No theoretical limitations are placed on transistor applications. The experts are optimistic about the possibility of overcoming present transistor limitations, *i.e.*, the higher noise level and the effects of heat and humidity upon its operation. Because the transistor is still in its infancy, it is undoubtedly just a matter of time until these problems are ironed out.

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*————: Proceedings of the IRE, November 1952.*


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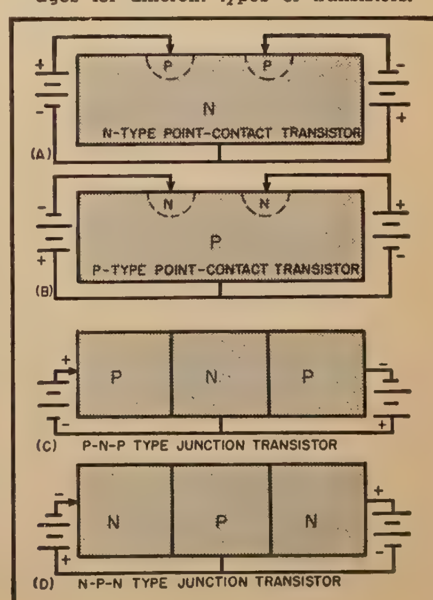
**Fig. 13. Emitter and collector bias voltages for different types of transistors.**



# TV TROUBLESHOOTING HIGH-VOLTAGE SUPPLIES

By
**MILTON H. LOWE**

*Flyback type high-voltage circuits: how they operate, and hints for time-saving receiver troubleshooting.*

A FEW years ago, before 19 and 21 inch picture tubes made their appearance, 9 or 10 kilovolts were all that were required to operate the average "kine." Nowadays, 15 kilovolts is quite common, and the high voltage required increases as picture tubes get larger. You have probably noticed that the physical size of components, such as the flyback transformer and high-voltage rectifier tube, have not kept pace with the demands placed upon them. If anything, the tendency is towards smaller and smaller parts whose values must be calculated critically in order to obtain the desired results. Replacing these parts without regard to tolerances and characteristics may cause troubles that did not exist before the repair was made. The best way to avoid these additional bugs is by being careful while troubleshooting, and by using correct replacement parts.

In an effort to improve the performance of the high voltage power supply, some 1953 television receivers utilize a flyback transformer of new design. It has a number of extra primary taps to which the damping diode is connected, in contrast to the older types where the damper is connected across the secondary. The principal advantage of this design is the reduction of transformer leakage inductance and distributed capacity, thus extending the high frequency response of the transformer. This results in a lower horizontal retrace time and, ultimately, reduces the problem of horizontal foldover due to lack of transformer response.

Typical varieties of the newest types of high-voltage supplies are shown in Figs. 1 and 2. Fig. 1 is the partial schematic diagram of the parts that comprise the high-voltage supply of *Admiral* chassis 19H1. The operation of this type flyback circuit is similar to the older types. The output of the horizontal oscillator is applied to the 6BQ6 horizontal output tube where it is amplified. The "Horizontal Drive" condenser and the 680 μμfd. coupling condenser comprise a voltage divider for the grid input signal. For proper operation of the circuit, the "Horizontal Drive" control is adjusted so that the saw-tooth shaped grid signal has a peak-to-peak amplitude of 65 volts. The 68-ohm grid loading resistor minimizes the tendency toward Barkhausen-type parasitic oscillations. A negative grid potential of approximately 24 volts is developed across the grid-leak network consisting of the 1-megohm grid return and the "Horizontal Drive" condenser (in series with the 68-ohm resistor). This potential, in conjunction with 5 volts of self bias developed across the 47-ohm cathode resistor, results in a total of approximately 30 volts of grid bias. This is a convenient number to remember when troubleshooting most horizontal output grid circuits, because one measurement from *grid-to-cathode* will indicate if the drive and bias are approximately correct. The amplified plate signal is applied to the horizontal deflection coils; stepped-down to produce the 1.5-volt filament potential for the 1B3; and stepped-up to produce the high voltage pulse, which is rectified and filtered to produce the high voltage output.

During the horizontal retrace, or flyback time, the horizontal out tube stops conducting, and a la pulse of voltage is developed acr the flyback transformer due to rapidly collapsing flux lines. T pulse would induce transient osci tions in the yoke were it not for damping diode, which is driven i conduction at this time, reducing magnitude of the voltage across coils and causing the oscillations decay quickly. The "pi" network, c sisting of the linearity coil and two .047 μfd. condensers, filter t rectified pulse to produce the "B boost voltage (approximately volts). A good point to remem about "pi" networks is that the in leg has the greatest effect on the a plitude of the network's output v age, whereas the output leg has greatest effect on the phase sl through the network. Thus, the . μfd. input condenser should be s pected if the boost voltage is too l and the output .047 μfd. conden should be suspected if the linearity the picture is unsatisfactory.

The linearity and width coils both tunable to provide for shap the horizontal deflection current shifting its phase with respect to applied voltage. These controls interacting and must be adjus alternately to obtain the desired p ture width and shape. The width is split into two parts so that a gi minimum of inductance shorts lower portion of the flyback tra former irrespective of the setting the width control.

Defects in the grid and screen cuits of the output tube produce syn toms similar to those obtained in a grid-leak biased audio amplifier. F example, if the 1-megohm grid ret should increase in value, there is strong possibility that the high v age would be intermittent in a fa ion that would be the visual count part of the aural motorboating eff If the .047 μfd. screen bypass sho become slightly leaky, the wi would be reduced somewhat. If t condenser should become very lea the brightness and/or width would noticeably affected.

Fig. 2 is a simplified schematic a flyback circuit that is a modified v sion of the type shown in Fig. 1. T circuit is used in the *Crosley* cha 387, *Motorola* chassis TS-410A, many other receivers, and is a bea ful example of simplified design. principal difference, compared to circuit of Fig. 1, is the noncontinu flyback primary. A 50-ohm pot tiometer, used for horizontal cen ing, separates the upper and lo portions of the flyback primary. No that a portion of the upper half of primary is tunable by means of adjustable slug. This provides a me for adjusting picture width by cha ing the high voltage by a sm amount (the picture width is a fu tion of two variables, namely sweep and high voltage, with the h voltage having the greater effe

| ..VER ..SIS No. | OUTPUT TUBE GRID | GRID TO CATHODE BIAS |
|---|---|---|
| SON 8-D 6-D | 120V. | -20V. |
| ROLA 95 00 10 | 70V. | -29V. |
| ANIA 7-3 7-1 | 105V. | -30V. |
| ONT 17 | 60V. | -28V. |
| RAL 2 | 90V. | -36V. |
| .COLUMBIA | 100V. | -35V. |
| PIC | 75V. | -35V. |

**..e 1. Signal waveshape and the bias ..the grid of the horizontal output ..s of some commercial TV receivers.**

.. apparent brightness is not af- ..d, because the change in high ..ge is very small, about 30 volts. ..vith a change of this order, the .. is visibly affected. Notice, also, .. the grid-leak bias is 27 volts, a .. close to that of the circuit in .. 1. The boost potential, approxi- ..ly +490 volts, is applied through ..horizontal centering control and ..output transformer to the plate ..it of the horizontal output tube. ..rallel *LC* network is used to de- ..e the horizontal deflection coils .. the damping circuit. The 2.2- .. high-voltage current limiting re- .. is used instead of a 4.7-ohm .. or to change the load that the ..ent winding presents to the ..ary.

.. older type flyback circuit using ..gh efficiency ferrite core in the ..former is shown in the simplified ..matic of Fig. 3. The 500 μμfd. ..enser connected from the 1B3 ..ent winding to the high side of ..econdary is the principal factor .. permits a 14-kilovolt output to ..btained from this type of circuit. ..plies a 3-kilovolt negative pulse, .. is developed at the high side of ..econdary at the same instant that ..ositive high-voltage pulse is de- ..ed across the primary, to the .. and thus boosts the over-all po- ..al across the high-voltage recti- .. The 550-volt boost voltage de- ..ed across the .22 μfd. damper- ..de filter is applied to the hori- ..al output plate circuit and to the .. first anode. The deflection coil ..nnected across the output trans- ..er secondary to obtain an opti- .. impedance match between the .. and the yoke, so as to minimize ..endency towards high-frequency ..ng, which would appear as alter- .. light and dark vertical lines or ..on the raster. The potentials de- ..ed in this circuit are much the .. as those in the previous two. ..word of caution is necessary be-

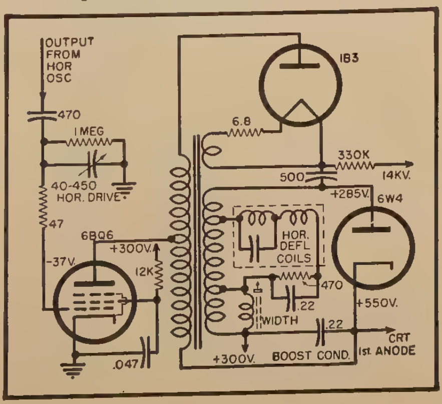
fore discussing the troubleshooting procedures. The most dangerous stages to troubleshoot are the horizontal output, damper, and high-voltage rectifier. Especially dangerous is the plate circuit of the horizontal output tube. This is due to the fact that the plate cap of this stage has a "B+" potential of from 400 to 600 volts in addition to an r.f. pulse of some 3 to 5 kilovolts. Thus, you have the combined dangers of the very lethal "B+" supply, and the possibilities of a "burn" from the r.f. Many technicians can attest to the fact that the plate cap of the output tube is far more "shocking" than the plate cap of the rectifier. Also, most test equipment is not designed to handle the high potentials found in these circuits. Therefore, specially insulated test leads, high voltage probes, and voltage dividers should be resorted to in order to obtain a proportional indication of the voltages and waveshapes present.

## Troubleshooting

Assume that the trouble symptom is a black CRT (sound normal). Only two possible troubles exist: either the CRT is dead or the high voltage is missing. A quick, though inconclusive, check of the CRT is to see if the heater is lit. If so, the trouble is probably in the high-voltage circuit, unless the customer has described symptoms that may lead you to believe that the CRT has gone. To check the high-voltage circuits, turn off the power and disconnect the lead to the CRT high-voltage button. Place the lead within ¼" of the chassis and turn the power on again. An arc should be drawn if the high-voltage circuits are operating. If the arc is drawn, either the CRT is defective, or the CRT biasing circuits, including the brightness control, should be checked for a condition that would prevent the CRT beam current from flowing. Do not allow the arc to be drawn for more than a few moments as the current-limiting resistor in the rectifier filament circuit may be damaged.

If the arc is not drawn, use a well insulated screwdriver to pull an arc from the plate cap of the rectifier. It should be about ⅜" long for a 15-

**Fig. 3. Capehart TV chassis CX-37 high voltage circuit furnishing 14 kilovolts.**



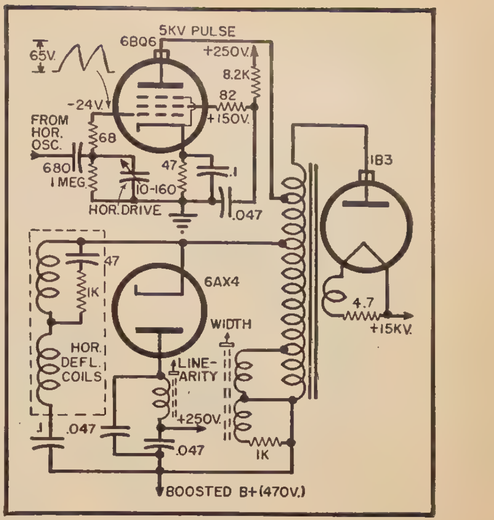




**Fig. 1. Partial schematic of the high voltage circuits of Admiral 19H1 TV chassis.**

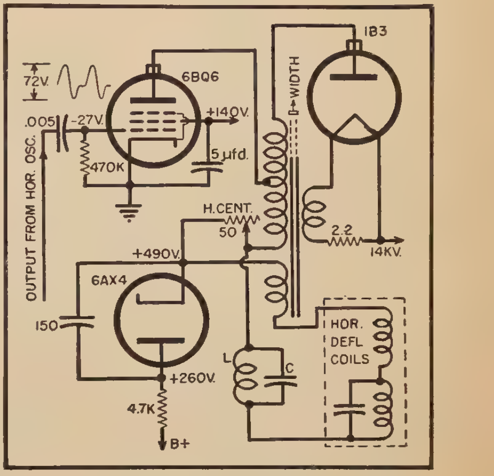



**Fig. 2. Flyback transformer circuit of the Motorola TS-410A and Crosley 387.**

kilovolt potential. If an arc is obtained at this point, but not at the end of the high-voltage lead, the high-voltage rectifier tube is probably defective. Also, check the high-voltage filter condenser, if a physical one is used. If the arc is appreciably less than ¼", the high voltage is too low and the CRT may not be bright for this reason. This point is discussed more in detail a little later. If an arc *is* obtained, touch the screwdriver to the plate cap of the horizontal output tube. Listen for a "click" in the speaker, and look for a very small spark at the point of contact. If both are obtained, the chances are that the output stage is OK. In this case, check the flyback transformer. (When the power is on, do not short the plate of the output tube to the chassis as this will cause either the low voltage fuse or low voltage rectifier tube to blow.)

A crude indication of the relative condition of the flyback can be obtained with an ohmmeter. The resistance from the plate cap of the output tube to the plate cap of the rectifier will range from 200 to 600 ohms, depending upon the type of flyback used.

(*Continued on page* 118)

# BUILDING THE E·V *Regency*

"Phantom" view of the Electro-Voice "Regency" enclosure.

By
**HOWARD SOUTHER**
Electro-Voice, Inc.

*Design details on a commercial folded horn enclosure which can be used with any high-quality 15" loudspeaker system.*

THE SEARCH for better bass response in loudspeaker systems proceeds apace. In the design of an enclosure for promoting superior reproduction in the lower octaves, certain practical considerations often enter into the choice of construction.

For instance, a room corner is not always available. This design includes an operational as well as functional styling which allows wall or corner placement. The height of the unit is sometimes important, because a window sill, picture, or series of shelves may intrude. Accordingly, the unit described is designed to standard lowboy height of approximately 29 inches, just missing the usual window sill and matching the height of other contemporary furnishings.

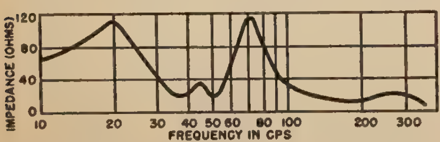



**Fig. 1. Impedance curve of the "Regency" with E-V 15-inch driver of 37 cps free-space resonance. See text for details.**

For the widest choice of driver complement, the acoustic loading permits a higher, more economical crossover point by allowing front radiation from the large driver cone. Thus, a high-frequency horn of small dimensions (the *E-V* Model 8-HD) can be housed within the structure with ease.

A horn is conceded to be the very best coupling medium for a high quality system. When this horn uses the corner of the room to extend the mouth opening, we have what is called a *folded corner horn.*. These horns call for a very low crossover and the use of multiple components when they are of the indirect radiator type, such as the *Klipsch* "K" design. A more compact and economical system with 800 cps crossover must include front radiation from the driver cone for the frequencies above 300 cps. This is because the higher frequencies experience difficulty in following the circuitous path of the folds.

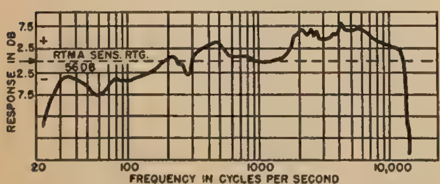



**Fig. 2. "Regency" frequency response with 114-A 800 cps separate two-way system.**

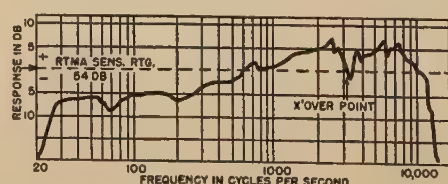



**Fig. 3. Frequency response of the "Regency" with the SP15 "Radax" coaxial driver.**

**Fig. 4. Intermodulation distortion with 114-A 800 cps separate two-way system.**

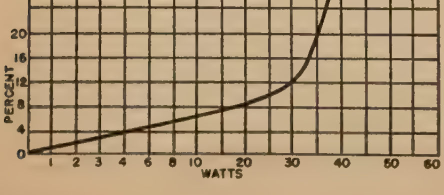
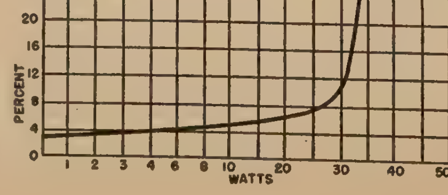



**Fig. 5. Intermodulation distortion with the E-V SP15 "Radax" coaxial system.**




The "Regency" is an acoustic s
tem of the latter type, permitting
rect radiation of the frequencies ab
225 cps and efficiently horn load
the back of the cone for the tones
low this point.

Because the "Regency" has its
integrally "built-in" corner with a
taper-rate, it may also be emplo
against a flat wall. In this case,
extended bass range is preserved,
at a slightly lower efficiency t
when used in a corner. The two si
of the cabinet, along with the fl
and adjacent wall, form a comp
horn, only the cabinet side of wh
is slightly compromised. Thus, v
satisfactory extended bass is achie
at good levels. The listening res
are supported by the impeda
characteristic (Fig. 1), showing a v
high reactive component in the 1
cps region.

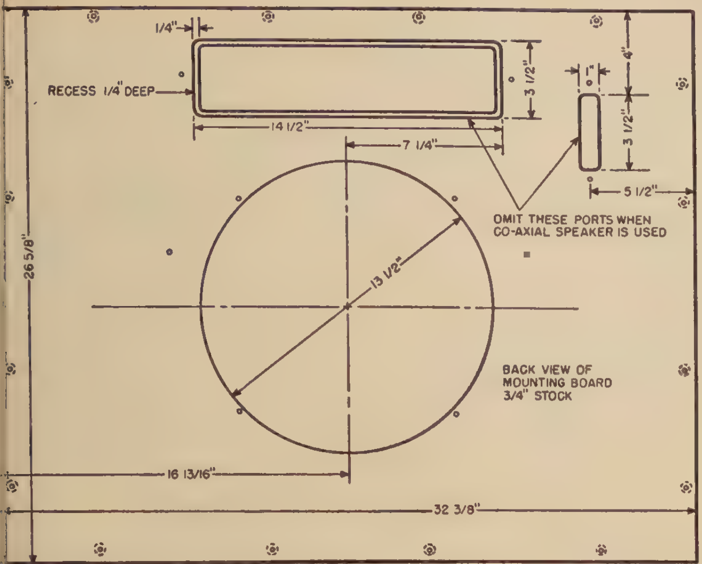
## Performance

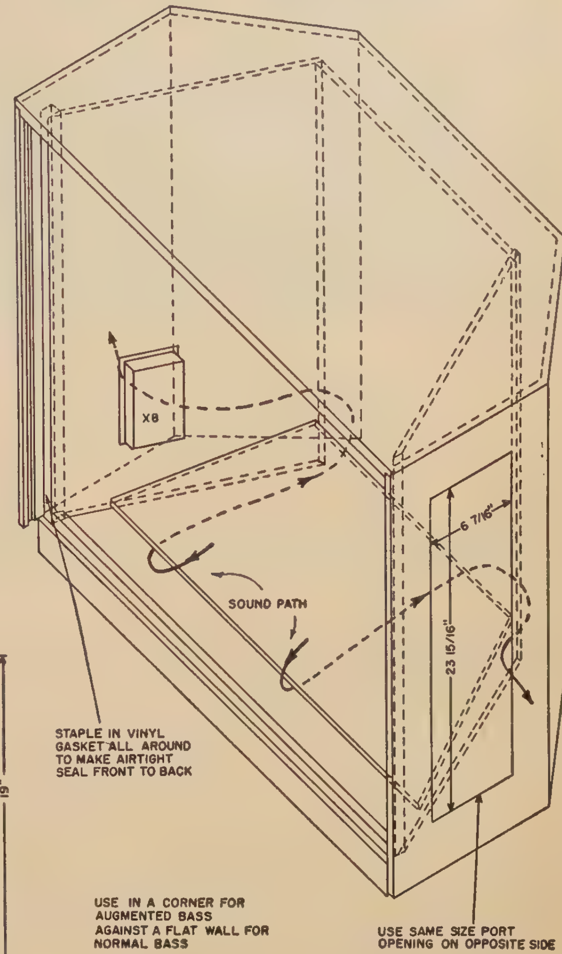
Performance with the *Electro-V*
114-A and 114-B two- and three-
systems using the 15W-1 15" c
driver, indicates unusual efficiency
the 30 cps region (Fig. 2). Harmo
distortion at the usual low room-p
ing levels is on the order of 2%.

A 15" coaxial driver (the *E-V* SP
shows no less than 3% distortion
low levels. Remarkably enough, at
higher levels around 10-15 watts
put, this driver shows less distor
than the multiple-way 114 series
tems. This is true because the
systems are more sensitive, or effici
and are being driven harder by
same power input. At the same
tening levels they have apprecia
less distortion than the coaxial uni

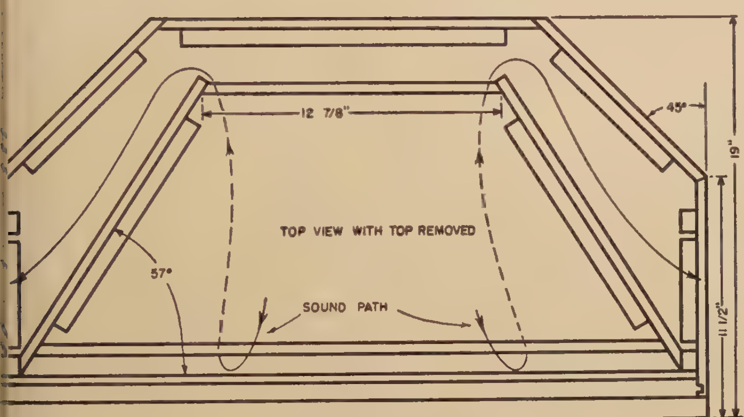
Where extended high-frequency
sponse is desired as a pleasing bala
to the bass efficiency, the *E-V*
"Super-Sonax" very-high freque
driver may be added as shown on
facing page. This is the equivalen
the 114-B three-way system, and
quires the supplementary X-36,
cps network and AT-37 high-freque
level control.

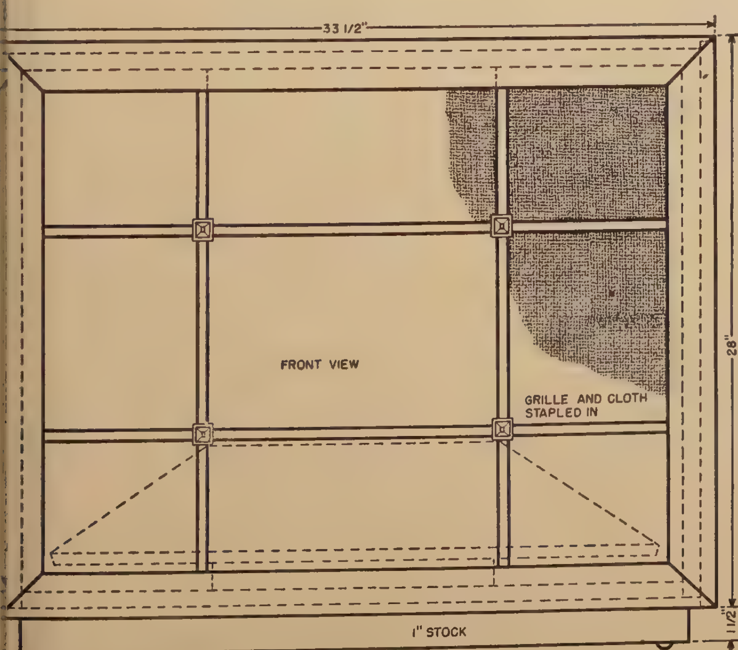
Mechanical details for constructing the Electro-Voice "Regency" loudspeaker enclosure. This housing is designed to accommodate a single 15" speaker, a 15" coaxial unit, or two- or three-way systems. For a two-way system it is necessary to add a high-frequency diffraction horn and with a three-way system a very high frequency tweeter is used.

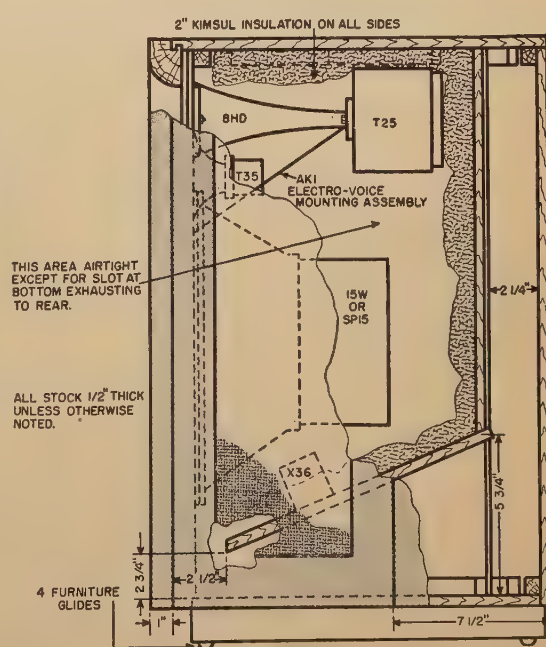



VIEW WITH FRONT MOUNTING BOARD REMOVED

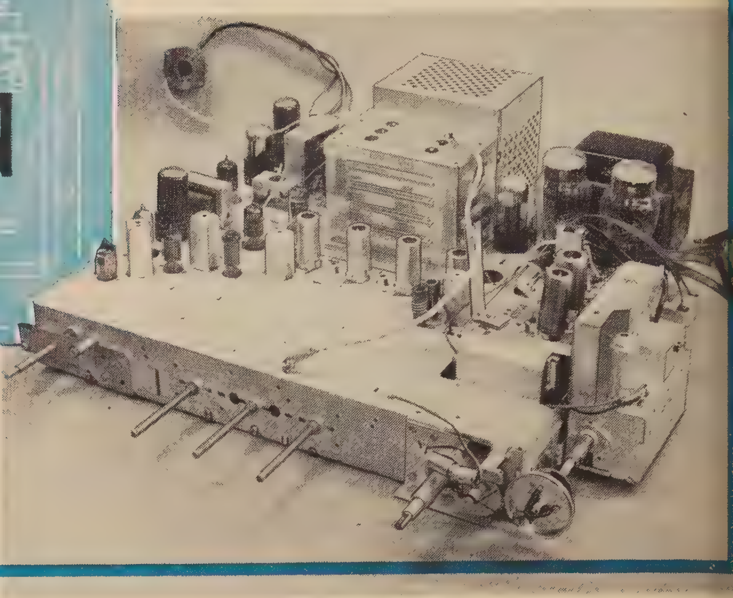


# KNOW YOUR 1953 EMERSON TV RECEIVERS

Front view of the Emerson chassis 120174B showing the u.h.f. tuner at the lower right.



By
**BRON KUTNY**
Educational Director
Emerson Radio & Phonograph Corp.

*Complete circuit explanation of the new Emerson u.h.f. tuner and u.h.f.-v.h.f. receiver with servicing data.*

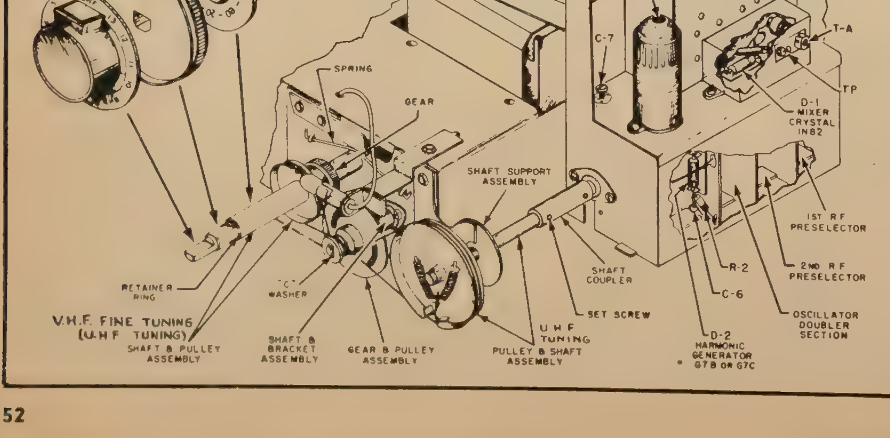
WITH more television stations going on the air daily, and with more communities being served by u.h.f. or v.h.f. stations, or both, *Emerson's* new line of TV receivers contains models suitable for all types of reception.

## Ultra-High Frequency Tuner

In the all-channel chassis 120174B, a continuous tuner is used in order to receive Channels 14 to 83. For the v.h.f. Channels 2 to 13, a cascode amplifier turret tuner is used. Tuning is accomplished by means of a two-part concentric control for both v.h.f. and u.h.f. so as to reduce the number of knobs necessary for the customer to handle, and also to simplify the appearance of the receiver. With this arrangement, the customer uses the channel selector and fine tuning controls for v.h.f., and only a single control, the v.h.f. fine tuner, for u.h.f. The fine tuning control is connected through a gear and dial cord arrangement to the u.h.f. tuner control shaft (Fig. 1).

Conventional balanced - to - ground 300-ohm input is provided for the u.h.f. tuner by two loops of wire fed through the tuner housing and fastened to the tuner chassis. (See Fig. 2.)

**Fig. 1. Combination of u.h.f. and v.h.f. tuners showing the tuning mechanism.**




The v.h.f. tuner uses the standard put coil arrangement.

The u.h.f. tuner consists of two preselector tuned circuits which equivalent to shorted-end reso lines. These lines are shorter tha quarter wavelength for all u.h.f. ch nels and, therefore, appear as ind ances whose electrical length car varied by the variable condenser the open end. The plates of this v able condenser are sometimes and may seem to be out of shape. *solutely no attempt should be n to straighten these plates.* They bent to maintain proper tracking the entire tuning range. The r.f. r nant lines are coupled through t respective shields, either by loops through openings, or by slots in shields.

A 6J6, operating as a push-pul cillator using lumped constants, o lates at one-half the desired freq cy. This push-pull arrangement its operation at a lower frequ contributes to stable operation. To tain the second harmonic frequ which is needed in the mixing ac the tank of the oscillator is cou to a harmonic generator G7B or crystal. The second harmonic quency output from the crysta coupled to a harmonic selector t line. The signals from this harm selector line, and the second r.f. selector, are fed through coils $L_5$ $L_6$ to a 1N82 mixer crystal ($D_1$ in 2). The 40-mc. output is then ap to the 13-position v.h.f. turret tu where the 6BK7 r.f. amplifier is used as a low-noise 40-mc. i.f. ar

. (See Fig. 3.) The 6J6, $V_2$, which the v.h.f. mixer and local oscillator receives no oscillator plate voltage the u.h.f. position and, therefore, oscillator section is completely inoperative during u.h.f. reception. The xer portion of the 6J6 has a negative voltage applied to its grid from negative tap on the power supply ough the u.h.f.-v.h.f. switch and .f. tuner test point, and it becomes other low-noise triode i.f. amplifier. e output from the i.f. preamplifier then fed to the standard 40-mc. i.f. plifier on the main chassis. In the .f. position, when u.h.f. oscillator eration is not required, the plate ltage is reduced but not eliminated. is is done to prevent cathode poisoning.

All u.h.f. tuners are pre-aligned at factory and will not normally require adjustment in the field. However, if the 6J6 u.h.f. local oscillator replaced, the tracking on the u.h.f. nd may be off slightly. Under these nditions, it would be best to try veral 6J6's until one with similar aracteristics to the original is und. If another tube is not available, it may be necessary to compensate for the minor difference by adjusting $C_T$ (see Fig. 1) slightly for the ghest channel received.

A combined u.h.f.-v.h.f. antenna can connected to the receiver through common 300-ohm lead-in, or separate .f. and v.h.f. antennas can be connected through independent lead-ins. n internal connector is provided for e with the common lead-in, and connects the antenna into the u.h.f. or .f. tuner when the channel selector rotated to the desired position. If parate antennas are used, this connector can be removed from the outside of the cabinet and requires no ternal adjustments.

The u.h.f.-v.h.f. switch, shown in the per left of Fig. 4, is automatically erated by a cam located on the .f. tuner shaft. This cam changes e switch from its v.h.f. position (as Fig. 4) to its u.h.f. position (slides e step down) whenever the v.h.f. ner is set for u.h.f. operation. In e v.h.f. position, the antenna is connected through switch contacts 8-9 d 17-18 to the high-pass filter $L_5$, d thence through switch contacts 3 and 11-12 to the v.h.f. tuner. "B+" supplied to the u.h.f. tuner through e 100,000-ohm resistor $R_6$, preventing e 6J6 in the tuner from oscillating t allowing some current flow rough the tube to prevent its cathode from being poisoned during long riods of v.h.f. reception when it is operative.

With the switch in the u.h.f. position, the v.h.f. antenna, or combination u.h.f.-v.h.f. antenna, is disconnected from the v.h.f. tuner and connected through switch contacts 7-8 d 16-17 to the input of the u.h.f. ner (terminals 3 and 4 on the connector TS-1 in Fig. 4). If a separate ad-in is used for u.h.f., it should be nnected directly to the u.h.f. tuner

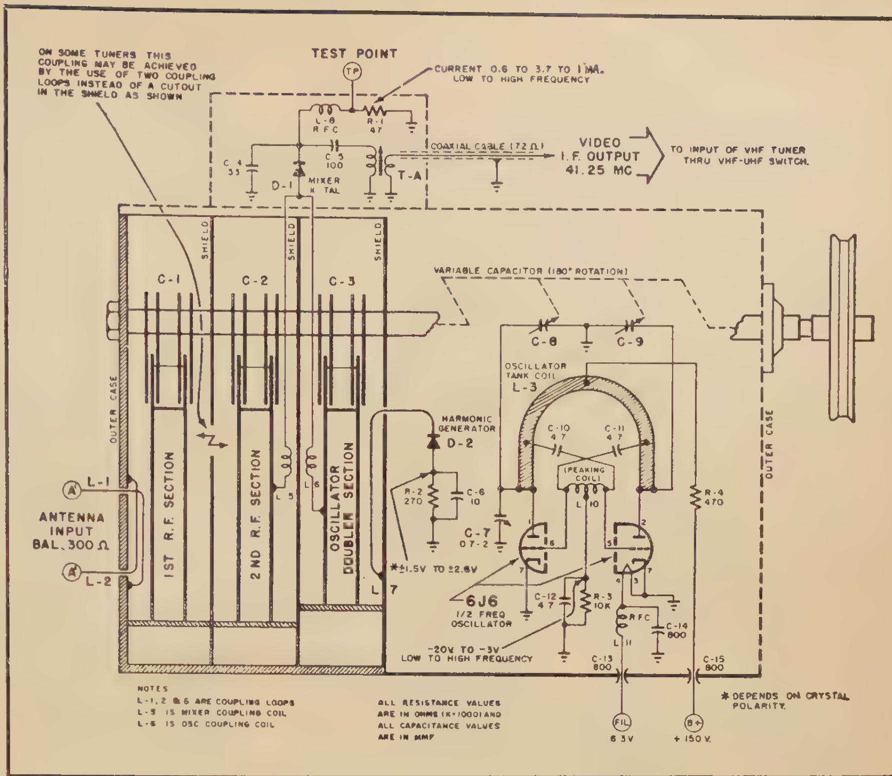



Fig. 2. Schematic diagram of the Emerson u.h.f. tuner showing test points.

antenna terminal; terminals 3 and 4 on the connector strip should be disconnected. The single-ended output of the u.h.f. tuner is fed through switch contacts 1 and 2 to the input of the v.h.f. tuner. The 100,000-ohm resistor, $R_6$, is shorted out by the switch through contacts 14 and 15, so that full "B+" (150 volts) is applied to the u.h.f. tuner. To enable the v.h.f. mixer tube to function as a 40-mc. amplifier when tuned to u.h.f., fixed grid bias is applied to the mixer through switch contacts 5 and 6 and the v.h.f. test point. Of course, the high-pass filter is switched completely out of the circuit for u.h.f. operation.

The i.f. amplifier is of conventional design, using three 6CB6's in three stagger-tuned stages. (See Table 2 for alignment of the i.f. amplifiers.) The first and second i.f. amplifiers are controlled by an a.g.c. line that is independent of the r.f. a.g.c. For this intercarrier receiver, the sound is taken from a 4.5-mc. take-off in the second detector output circuit and fed to the sound i.f. amplifier. The signal is limited by a 6AU6, detected by a *Foster-Seeley* discriminator, and then fed to a conventional audio output circuit. Table 2 contains alignment instructions for the sound section of the receiver.

## Delay in Tuner A. G. C.

A subject worth going into is the a.g.c. because of its deviation from the common types of a.g.c. found in most receivers. To appreciate the

Fig. 3. Schematic diagram of the Emerson v.h.f. tuner described in the text.

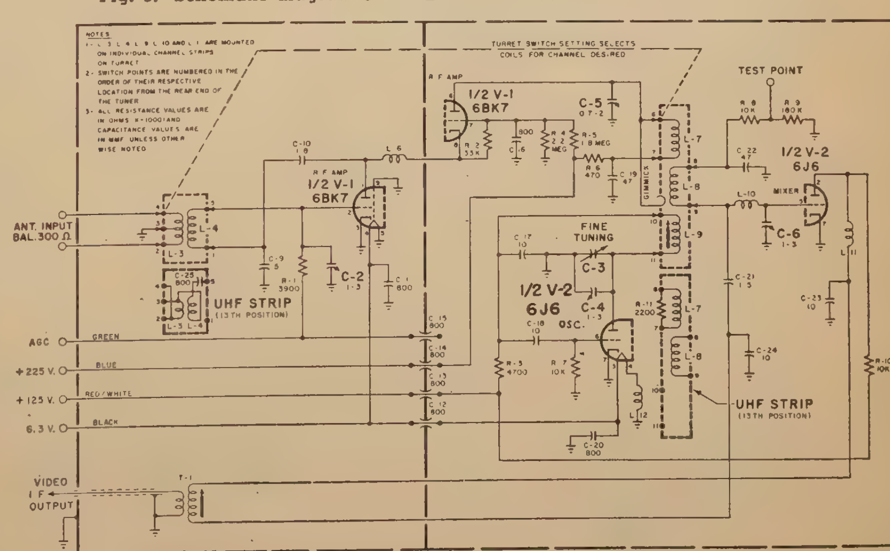
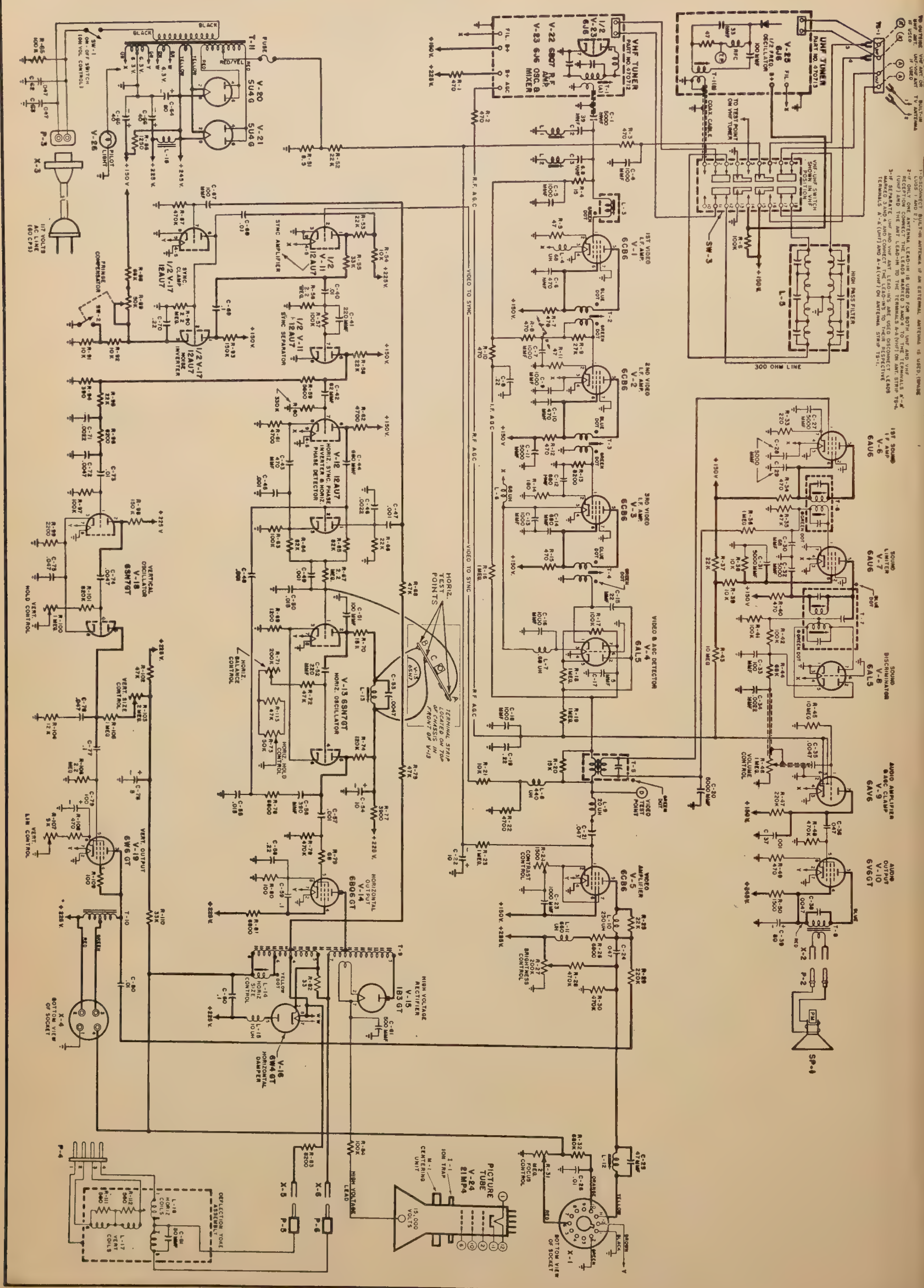


Fig. 4. Complete schematic diagram of the Emerson 120174B chassis.



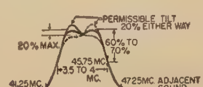
ion, the need for it must be un-
od.
ly television receiver a.g.c. sys-
fell into one of three general
ories:
o a.g.c.
imple a.g.c., where the control
e is obtained from the negative
omponent developed across the
detector load resistor. (Fig. 5A.)
oltage-doubler a.g.c., using a
ate diode to rectify the compos-
deo signal at the output of the
nplifier, and adding it in series
the simple a.g.c. developed by
d 2. (Fig. 5B.)
requirements for a good a.g.c.
no doubt, been seen by many television technicians but, more often than not, not understood. To give examples of two extremes, when a technician installed a receiver in a strong signal area, the picture would become extremely contrasty and, on some receivers, there would be a complete loss

(*Continued on page* 114)

| COMPONENT | CHECK POINT | VARIATIONS LOW TO HIGH FREQUENCY | POSSIBLE TROUBLE (If voltage readings are not normal) |
|---|---|---|---|
| 6J6 | "B+" | +150 v. | $C_{10}$, $C_{15}$, $C_{11}$ shorted, the v.h.f.-u.h.f. switch. |
| | Filament | 6.3 v.a.c. | $L_{11}$ open, $C_{14}$, $C_{13}$ shorted. |
| | $R_3$ | −20 v. to −3 v. | $R_3$ open, $C_{12}$ shorted. $L_{10}$ open or shorted. |
| $D_2$ Harmonic Gen. Crystal | $R_2$ | ±1.5 v. to ±2.6 v. | Crystal defective, $L_7$ shorted to chassis, $C_7$ shorted. Voltage polarity depends upon crystal polarity. |
| $D_1$ Mixer Crystal | Current through $R_1$. Insert milliammeter | 0.6 through 3.7 to 1 ma. | $D_1$ defective, $C_4$ shorted, $L_8$ open. |

**Table 1. Troubleshooting data for the Emerson u.h.f. tuner.**

**Table 2. Alignment procedure for the video i.f. and sound circuits of the Emerson 120174B chassis.**

| EP | SIGNAL GENERATOR FREQUENCY | SIGNAL GENERATOR CONNECT TO | OUTPUT INDICATOR | CONNECT TO | ADJUST | REMARKS |
|---|---|---|---|---|---|---|
| | **VIDEO I. F. ALIGNMENT** | | | | | |
| 1 | 45.75 mc. unmodulated | Floating shield of converter tube $V_{23}$ (6J6) | V.T.V.M. | Video test point D | $T_4$ for maximum reading | Adjust output of signal generator so that maximum response does not produce more than −2 v. d.c. on V.T.V.M. |
| 2 | 43.2 mc. unmodulated | Same as above | Same as above | Same as above | $T_3$ for maximum reading | |
| 3 | 42.0 mc. unmodulated | Same as above | Same as above | Same as above | $T_2$ for maximum reading | |
| 4 | 45.0 mc. unmodulated | Same as above | Same as above | Same as above | $L_3$, $T_1$ for maximum reading | |
| 5 | 41.25 mc. unmodulated | Same as above | Same as above | Same as above | $L_2$ for minimum reading | Increase output of signal generator |
| 6 | 47.25 mc. 400 cycles amplitude modulated | Same as above | Oscilloscope gain near maximum; horizontal sweep at 400 cycles | Same as above | $L_1$ for minimum vertical deflection | Set signal generator at maximum output |
| 7 | 44 mc. center frequency. 10 mc. sweep. Marker generator at 45.75 mc. | See Fig. 8 | Oscilloscope | Same as above | $T_4$ for waveform below   | Set signal generator output as low as possible |
| | **SOUND ALIGNMENT** | | | | | |
| 8 | 4.5 mc. unmodulated or tune to on-the-air TV channel | Pin 7 of $V_4$ (through .01 $\mu$fd. condenser) | V.T.V.M. (through 10,000-ohm resistor) | Junction of $C_{30}$, $R_{35}$, and $R_{36}$ | $T_5$ top or bottom for maximum reading. $T_6$ top and bottom for maximum reading | Adjust signal generator output (or antenna coupling) to produce a 1-volt d.c. rise on meter. If using signal generator short pin 1 of $V_3$ to chassis |
| 9 | Same as above | Same as above | Same as above | Junction of $R_{44}$ and $C_{34}$ | $T_7$ secondary for maximum negative reading | $T_7$ secondary adjustment is on top for part #708018, #708151; on bottom for part #708017 |
| 10 | Same as above | Same as above | Same as above | Same as above | $T_7$ primary for maximum negative reading | |
| 11 | Same as above | Same as above | Same as above | Same as above | $T_7$ secondary for zero d.c. reading | |
| | **4.5 MC. VIDEO TRAP** | | | | | |
| 12 | 4.5 mc. unmodulated | Pin 2 of $V_5$ (through .01 $\mu$fd. condenser) | V.T.V.M. (negative scale) | Junction of $R_{34}$, $T_6$, and $C_{29}$ | $L_8$ for minimum negative reading | Short pin 1 of $V_3$ to chassis. Set contrast control completely counterclockwise. Repeak $T_5$ |

# SIX-METER EMERGENCY TRANSCEIVER

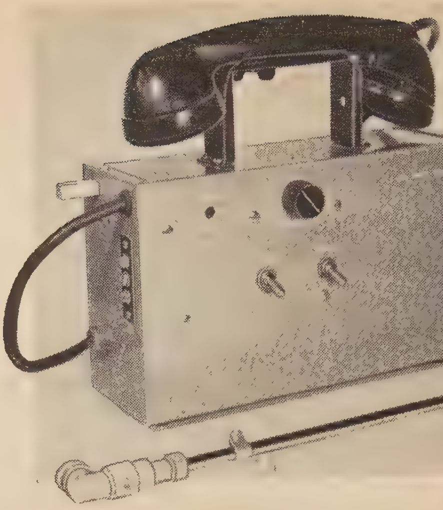
By

**ROBERT L. HANKEY, W3OBC**

and

**MAURICE P. JOHNSON, W3TRR**

**WAAM (TV) Engineering Dept.**



**Above, the six-meter transceiver with its antenna. Controls are "tone-voice" switch, regeneration, and battery "on-off." Small hole is for receiver tuning. At right, one of the transceivers is shown in operation.**

*The six-meter amateur band has advantages in equipment and performance over both "ten" and "two" for CD and other portable-emergency work.*

THE DESIGN of most emergency amateur equipment, portable gear intended to be carried by hand in particular, is necessarily a compromise dictated by the unyielding demands for lightweight, small size, and low battery drain. Naturally this results in simple receivers and low power transmitters. To obtain any degree of reliable communication between such units, the choice of operating frequency warrants careful consideration.

Persons aware of current trends in emergency equipment probably already realize that the six-meter band is being favored as the band best suited to this type operation. Six meters gives satisfactory coverage, yet is not cluttered with the QRM so typical of the more active lower frequencies. Reasonably efficient designs for six-meter gear are possible with conventional components and without complex circuitry, since the band is within the frequency ratings of most miniature tubes. Another point of amateur interest is the antenna efficiency which can be obtained with reasonable antenna lengths.

For these and other reasons the FCDA prefers six meters for *RACES* (Radio Amateur Civil Emergency Service) use rather than the more popular ten-meter band. Local coverage is likely to be more reliable because "six" is less frequently bothered by DX interference, which can be a serious factor. The FCDA's plan for "matching funds" to supplement community expenditures for CD radio does not allow for the setting up of new ten-meter systems, although it does allow for replacement and growth in existing systems. A community about to set up a *RACES* system, or an existing system wishing to add a network of hand-carried portables, would do well to consider six meters.

The six-meter, hand-held transceiver discussed here is the first of several equipment designs being undertaken to provide a complete portable and emergency service, and is thus well suited to Civilian Defense needs. This transceiver meets the demands for a compact, lightweight, battery-powered unit, entirely self-contained, intended for use at locations that would be inaccessible to mobile or other equipment.

As six meters had been selected as the most promising band for the equipment, considerable effort was directed toward an efficient transceiver design. Previously published material was carefully perused, and several worthwhile ideas gleaned, but no design was encountered which completely met our requirements. It was therefore decided to establish our own design criteria, and make trial constructions and tests to check the various circuits examined.

Ordinary modulated oscillators and superregenerative receivers were combined in some of the simplest transceiver designs and a test of such a circuit was made. A two-tube set was constructed, one tube for the oscillator and detector, the other as modulator and audio amplifier. The circuit adapted itself to extremely compact construction and low battery drain, but the faults inherent in its simplicity did not permit the unit to meet our specifications. The transmitter proved to be much too unstable for dependable fixed-frequency reception, and the superregenerative detector produced excessive radiation. Body-capacity effects on the antenna affected stability to a great degree, which was considered especially undesirable in a hand-held transceiver.

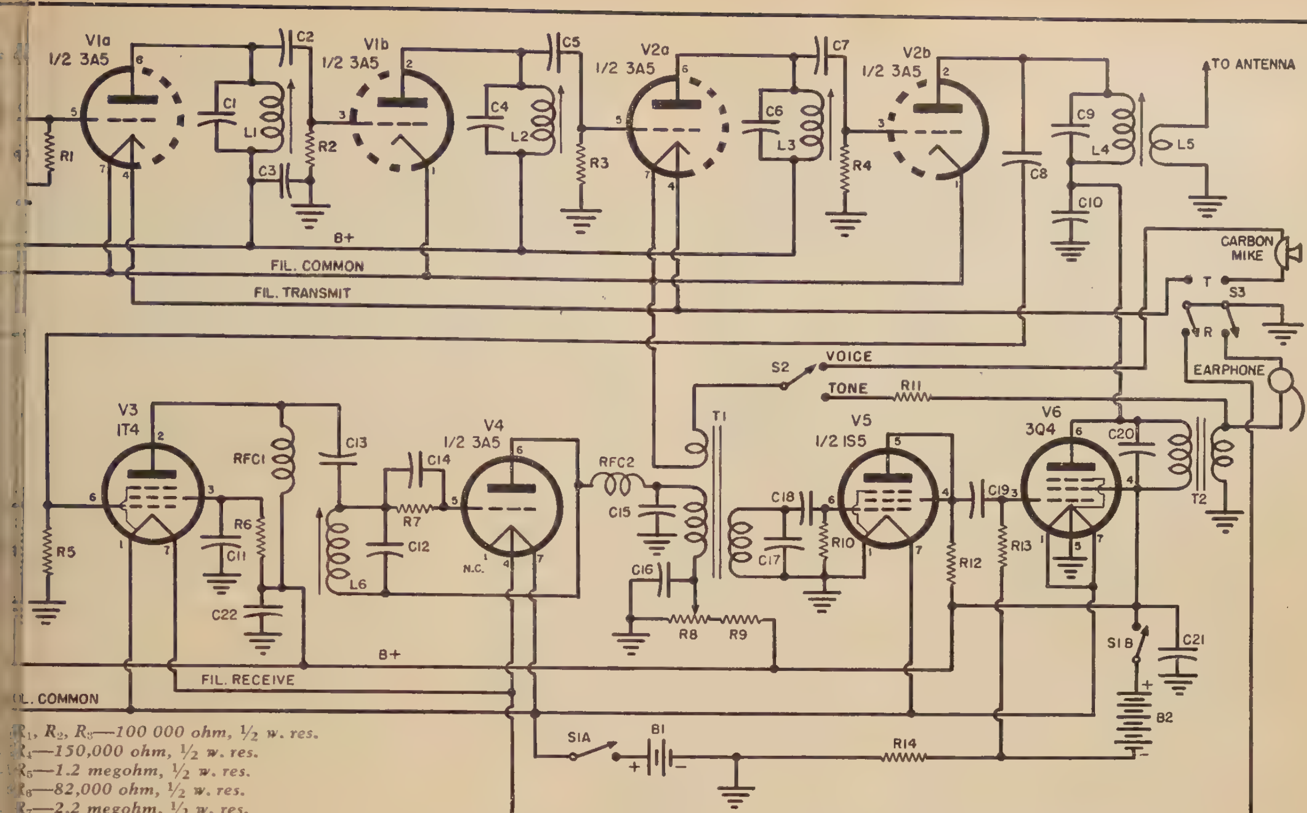
These tests of the simplest tr ceiver circuits indicated that s what more refined circuitry woul necessary if any degree of reliab was to be obtained.

The circuit which finally evo after considerable study, test, and cussion is a carefully balanced cl of the features needed to provide desired stability and dependab without undue weight or bat drain. As the design of the proto units progressed, every effort made to avoid special, subminia or surplus parts, so that duplic could be more easily accomplishe

Our contemplated six-meter pr is based upon single-frequency work-type operation, with transce intermingled with other mobile- able and fixed station equipment, with the majority of receivers tended for fixed-frequency opera Therefore, crystal control of transmitter became almost mand in the interest of frequency stab Harmonic-type oscillator circuits rejected in favor of a convent triode oscillator with multiplier st since the latter was considered s what less difficult to adjust and

Four stages in the r.f. lineup use of two dual-triode tubes, mult ing the crystal frequency eight to produce the six-meter carrier. oscillator plate circuit tunes to crystal frequency, with each fo ing stage functioning as a dou Operating the final amplifier doubler admittedly reduces the ciency, but this slight sacrifice a the necessity of neutralization.

A receiver of comparable per

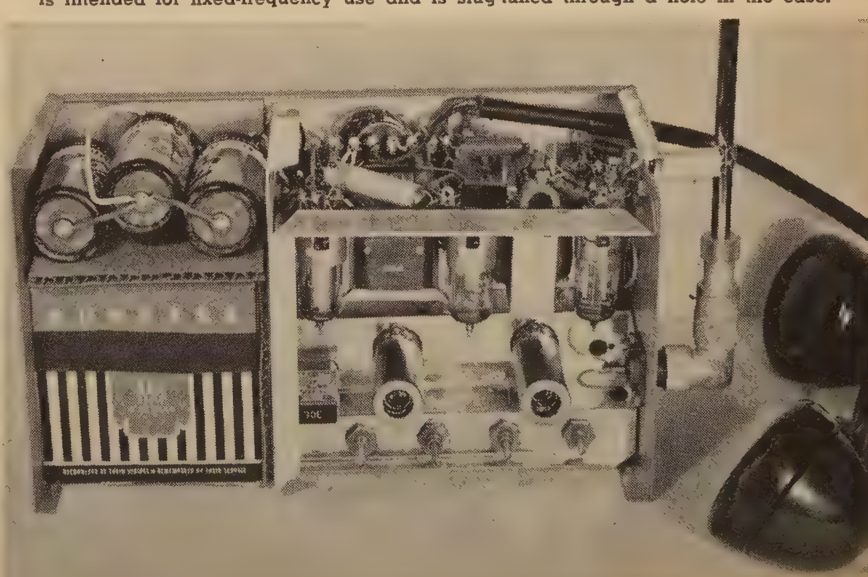


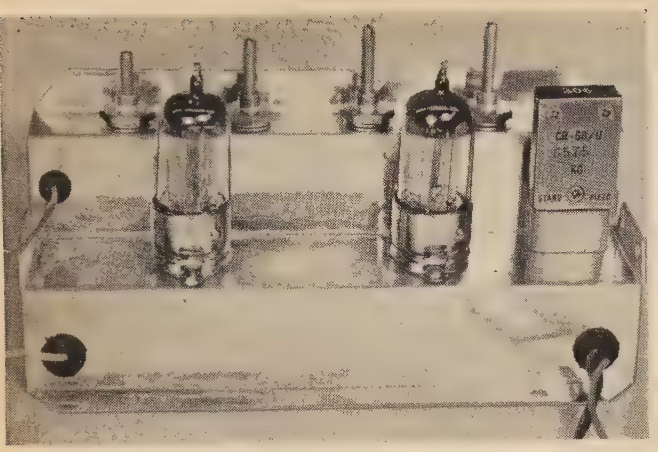

$R_1$, $R_2$, $R_3$—100 000 ohm, ½ w. res.
$R_4$—150,000 ohm, ½ w. res.
$R_5$—1.2 megohm, ½ w. res.
$R_6$—82,000 ohm, ½ w. res.
$R_7$—2.2 megohm, ½ w. res.
$R_8$—50,000 ohm miniature pot
$R_9$—10,000 ohm, ½ w. res.
$R_{10}$—10 megohm, ½ w. res.
$R_{11}$—27,000 ohm, ½ w. res.
$R_{12}$—47,000 ohm, ½ w. res.
$R_{13}$—470,000 ohm, ½ w. res.
$R_{14}$—270 ohm, 1 w. res.
$C_1$—50 μμfd. ceramic cond.
$C_2$, $C_5$, $C_7$, $C_{22}$—100 μμfd. ceramic cond.
$C_3$, $C_{10}$, $C_{17}$—680 μμfd. ceramic cond.
$C_4$—15 μμfd. ceramic cond.
$C_6$, $C_9$, $C_{12}$—5 μμfd. ceramic cond.
$C_8$—10 μμfd. ceramic cond.
$C_{11}$, $C_{20}$—.001 μfd. disc ceramic cond.
$C_{13}$, $C_{14}$—50 μμfd. ceramic cond.
$C_{15}$—.002 μfd. disc ceramic cond.
$C_{16}$—.25 μfd., 200 v. miniature cond. (Aerovox P-282)
$C_{18}$—.01 μfd., 200 v. miniature cond. (Aerovox P-832)
$C_{19}$—.01 μfd., 200 v. miniature cond.
$C_{21}$—10 μfd., 150 v. elec. cond. (Aerovox SRE Bantam)
$RFC_1$, $RFC_2$—7 μhy. r.f. choke (Ohmite Z-50)
$L_1$—30 t. #26 en.
$L_2$—24 t. #24 en.
$L_3$—13 t. #20 en.
$L_4$—8 t. #16 en.
$L_5$—2 t. hookup wire, wound over cold end of $L_4$ (output link)
$L_6$—8 t. #16 en.
Note: All coils ½" dia., 11/16" long, wound on National XR-50 forms. (Turns spaced to fill winding space)
$S_{1A}$-$S_{1B}$—D.p.s.t. toggle sw.
$S_2$—S p.d.t. toggle sw.
$S_3$—Handset sw., modified (see text)
Xtal—6250 to 6750 kc., determined by desired freq.
$B_1$—Three size "D" 1½ v. flashlight cells in parallel
$B_2$—Two 90 v. batteries in parallel (Burgess N60 or equiv.)
Carbon mike, earphone—Part of TS-9-AJ telephone handset (see text. Purchased from Telephone Engineering Co., Simpson, Pa.)
$T_1$—Transceiver input trans., 200 and 5000 ohms to 60,000 ohms (Stancor A3833)
$T_2$—Transceiver output trans., 10,000 ohms to 50 and 2000 ohms (Stancor A3836)
$V_1$, $V_2$—3A5 tube
$V_3$—1T4 tube
$V_4$—½ 3A5 tube
$V_5$—1S5 tube
$V_6$—3Q4 tube

**Schematic of the six-meter CD and emergency portable transceiver. The two audio tubes are shared by transmitter and receiver; the transmitter output tank coil doubles as an input coil for the receiver r.f. stage, thus eliminating antenna switching. Otherwise the transmitter is distinct from the receiver, unlike the usual tube-sharing "transceiver" circuit.**

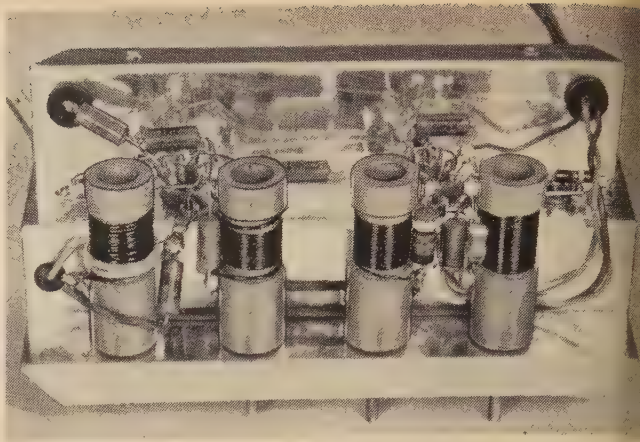
y was the next objective. Examination of the superheterodyne circuit cated that the inherent complexity for even moderate sensitivity ld not be justified in this application. The excellent sensitivity of the erregenerative detector makes it thy of consideration. It posseses a ree of a.v.c. action in itself, and its ntly broad bandpass characteristic ot particularly objectionable for fixed-tuned receiver on an unvded band. Furthermore, its simity lends itself admirably to a pact construction such as this. triode circuit was found to proe the smoothest performance in particular unit. One-half of a was finally used as about the only e available. Control $R_8$ is the reeration control, made variable to w adjustment for battery voltage nges, and to permit optimum detecoperating adjustments. The values $C_{14}$, $R_7$, and $C_{15}$ all affect the operaand the listed values were those ch gave best results in this circuit.

**A view of the transceiver with the cover removed and antenna attached. The transmitter and receiver occupy separate chassis, simplifying construction. The receiver is intended for fixed-frequency use and is slug-tuned through a hole in the case.**





**The transmitter chassis, showing small size and simplicity of the unit. Grommet at upper left carries the antenna lead; the other is for receiver input. Modulator is on receiver chassis.**



**Under-chassis view. Oscillator at right operates on crystal fundamental; all other stages, including final, are doublers. Parts are standard. Chassis is cut from a transcription disc.**

The primary objections to the super-regenerative detector, namely oscillator radiation and antenna loading effects, were remedied in this receiver by incorporating an r.f. stage to isolate the detector from the antenna. A pentode amplifier is used which helps to increase the sensitivity of the receiver.

The use of an antenna changeover relay or switch was avoided in a practical and convenient manner. Coil $L_4$, together with $C_9$, serves the dual role of tank circuit for the transmitter final and also tuned input for the receiver. Condenser $C_8$ and $R_5$ form the receiver coupling, and by proper choice of values very little energy is lost when transmitting.

The requirements of the modulator and receiver audio amplifier were easily combined in a common circuit using two tubes. One winding of a dual-purpose input transformer couples the detector to a pentode voltage amplifier. The other primary introduces the single-button carbon mike when transmitting. The button current is drawn from the filament string. Contact bias on the voltage amplifier produces excellent gain in the stage, which is *RC*-coupled to the power output tube. The output transformer secondary matches the tube to the receiving earphone, and the primary is used for the Heising modulator.

The selector switch $S_2$ injects a sidetone which makes a very convenient modulating signal for alerting or tuning the receiving station. Proper phasing of the windings in the feedback loop is essential to generate the tone.

The power changeover for "transmit-receive" switching is accomplished by $S_3$. Half of this d.p.d.t. switch completes the ground path for the filaments of each section as required, while the other half completes the mike or earphone circuit, depending upon the use. The dual-purpose audio section operates continuously as it functions during both reception and transmission.

The advantages of having this push-to-talk changeover incorporated as a switch in the handset were obvious. Several TS-9-AJ handsets with butterfly switches were available, and these were carefully rebuilt as d.p.d.t. switches by using thinner insulating spacers and adding two switch leaves. The "receive" contacts were adjusted to be normally closed. A length of four-wire cable with a shield for the ground return was connected from the handset to the transceiver proper.

Should this handset revamping be considered too laborious to the co[n]structor, the same electrical resul[t] can be accomplished by mounting [a] spring-return switch on the tran[s]ceiver within easy reach of the carr[y]ing handle.

The handset clips into the carryin[g] handle when not in use. This hand[le] is a U-shaped bracket which w[as] folded from 1/16-inch aluminum sto[ck] in such a manner as to grip the han[d]set snugly.

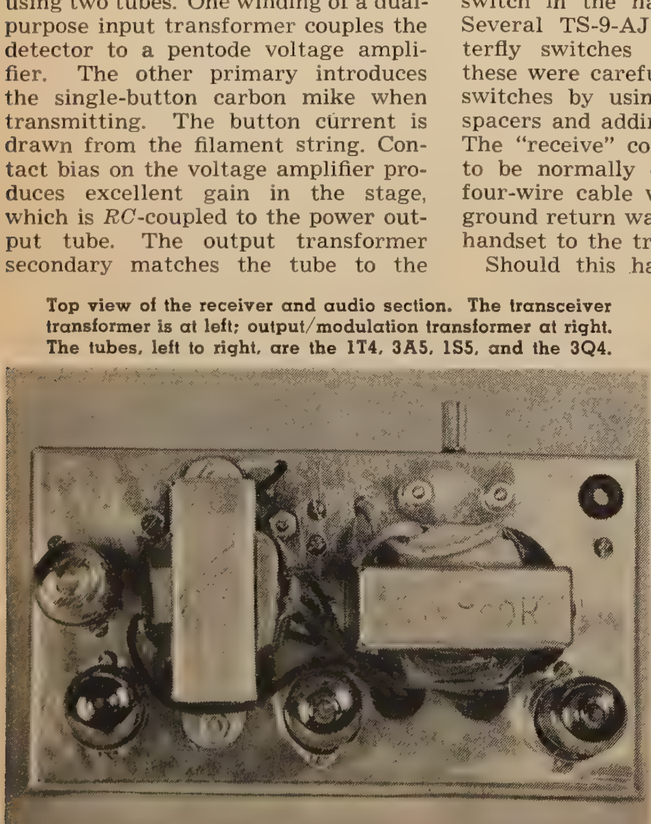
The controls on the front panel a[re] the regeneration control, the "ton[e]-voice" switch, the battery "on-of[f]" switch, and an access hole for tuni[ng] the receiver slug. The antenna moun[ts] on the front end of the cabinet an[d] if desired, a terminal strip can [be] included for external battery conne[c]tions.

It is suggested that a careful stu[dy] of the schematic, photographs, a[nd] sketches be made before duplicati[on] of the transceiver is undertaken. T[he] parts layout and method of constru[c]tion will be evident from the phot[os]. Careful adherence to the layout a[nd] listed parts is suggested to circu[m]vent unnecessary complications in a[s]sembly.

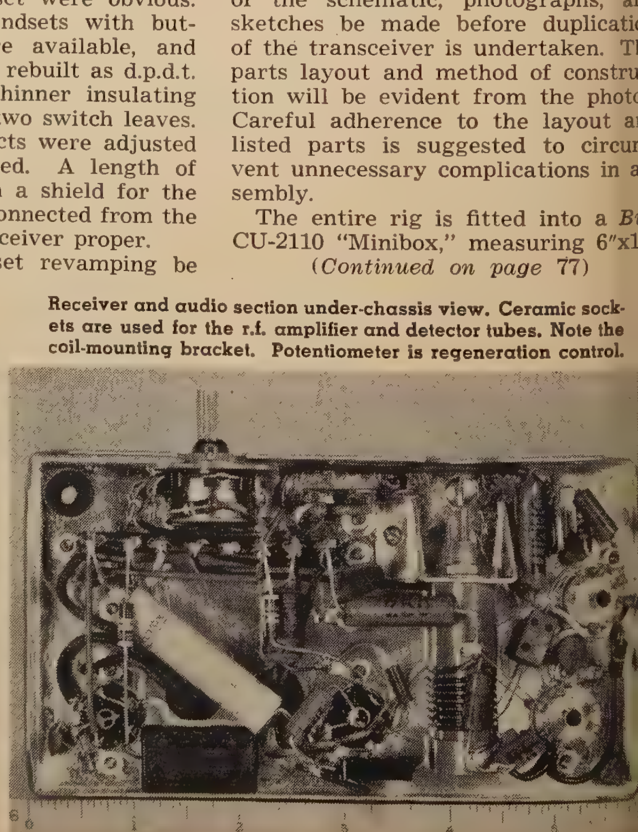
The entire rig is fitted into a *B*[...] CU-2110 "Minibox," measuring 6"x1[...]

(*Continued on page* 77)

**Top view of the receiver and audio section. The transceiver transformer is at left; output/modulation transformer at right. The tubes, left to right, are the 1T4, 3A5, 1S5, and the 3Q4.**

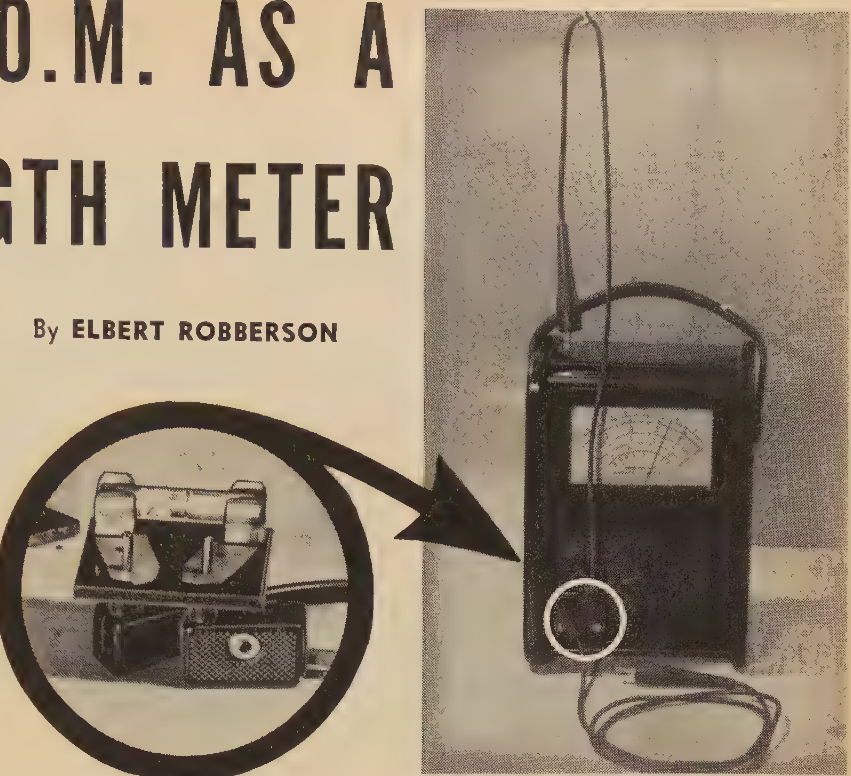


**Receiver and audio section under-chassis view. Ceramic sockets are used for the r.f. amplifier and detector tubes. Note the coil-mounting bracket. Potentiometer is regeneration control.**



# DAPTING V.O.M. AS A IELD STRENGTH METER

By **ELBERT ROBBERSON**



**A common volt-ohm-milliammeter is quickly converted to a sensitive field-strength meter by connecting a crystal diode across the input terminals by a simple adapter. Meter leads plug through the adapter, securing it and providing an antenna.**

*This simple adapter converts a transmitter technician's v.o.m. into a field-strength meter for on-the-spot checks.*

ANSMITTER workers, both amaur and professional, have long own that the *field strength meter* etter for tuning up output and nna circuits than antenna amrs, plate milliammeters, or any single instrument. All too often, ver, it is not used—either be- one is unavailable for some rea- or because it would represent one more bulky object to be added e already heavy load of instrus and tools to be carried to the

e photograph at right above shows dapter which will convert the cononal volt-ohm-milliammeter nory carried by a technician, into a tive field strength meter which give accurate relative measurecs of actual radiated power on any ency up to thousands of megas.

e sensitivity may be judged from fact that the pointer of the innent in the photograph is being cted ⅔ of full scale, or about 68 amperes, by the relatively feeble nt of power being generated (in case on 50 megacycles) by a gridscillator in the same room.

e adapter requires no power e, weighs only one-half ounce, e tucked away in the meter-lead artment of the instrument, and, of all, it can be made in minutes surplus and scrap.

general aspect is shown in the o above (left). The heart of the ter is a 1N21 radar crystal, used detector. The mechanical de- of the adapter connects the cryscross the meter input, in parallel the normal leads, which are used pickup dipole antenna. Since the h of the leads determines the nant frequency of the detector, a al pair may be used for any parrly important frequency, or they be tuned by rolling them up, or ing onto other nearby metallic ts to add length to the antenna.

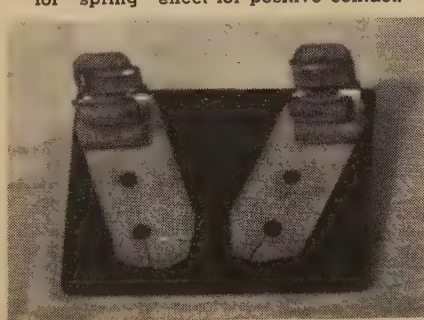
e simplest mounting base is one e Bakelite fuse strips found in t every major surplus equipment One of the pairs is sawed off, ng enough Bakelite on one side at it will cover the input jacks. o strips of thin brass stock (photo ) are cut to the approximate e shown, and fastened under the clips. Two holes *one size smaller* the exact diameter of the meter- plugs are drilled through the s and the Bakelite, and the brass s slit as shown so they form spring contacts. The holes in the Bakelite are reamed slightly so the plugs fit snugly. The hole spacing should be exactly the same as that in the meter, so the plugs will fit through the adapter holes and into the meter jacks.

The cartridge-like rim on the end of the surplus crystal is then filed off, and a piece of ¼" rod, either brass or aluminum, is then cut to make up the length between the fuse clips, and is drilled in the end to take the crystal tip. The extension is slipped onto the tip, and the assembly is clipped into the holder, just like a fuse.

Of course the crystal must be clipped in with the correct polarity to make the meter read properly.

If it is desired to make use of the later model crystals with pigtail leads,

**The fuse clips and brass contact strips are mounted as shown. Strips are slit for "spring" effect for positive contact.**



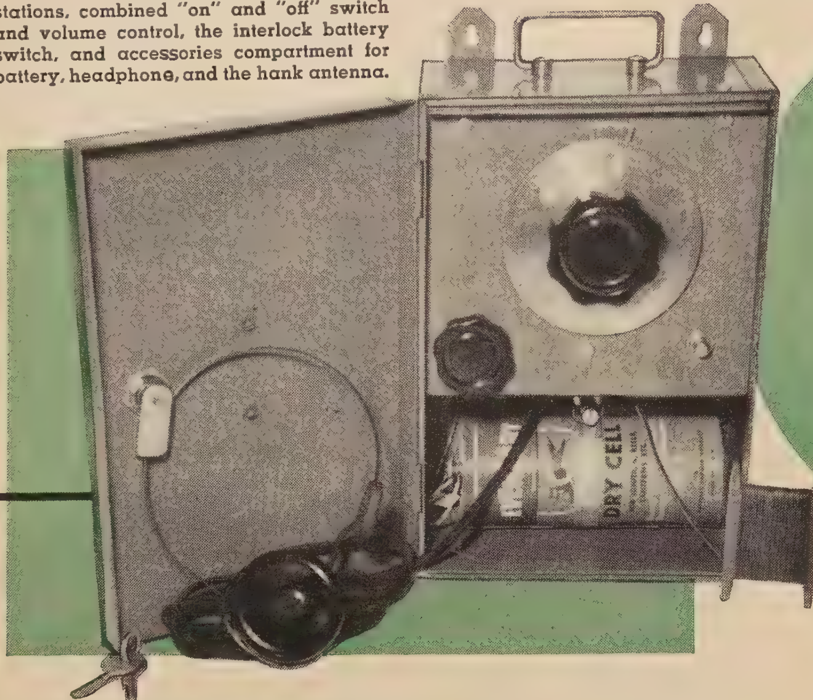
solder lugs may be substituted for the fuse clips, and the crystal mounted between them.

In the field, the test leads and the adapter are plugged into the meter, the selector switch set on the microampere position, care being taken, if transmitter power is high, not to "pin" the meter. If pickup is too great for safety to the meter, the leads may be shortened or rolled up. If insufficient pickup is obtained, the leads may be connected to other metal objects.

The meter should be placed as far away as working area and vision permit so that movements of the operator will not affect the indications and in order that direct pickup from the transmitter is minimized. An example of correct placement would be the case of tuning a small boat transmitter, with the meter placed in sight of the operator on the stern of the boat or preferably, on the dock. With transmitters located on dry land the possibilities for placement of the meter are virtually unlimited, and fences, automobiles, trees, etc., may be used to support or augment the antenna.

With correct placement and a proper pickup circuit, excellent comparisons may be made for tuning transmitters of as little as five watts' output. The adapter can be used with any instrument having a microampere or sensitive low-voltage scale. —30—

Fig. 1. External view of the security radio showing large dial for accurately logging stations, combined "on" and "off" switch and volume control, the interlock battery switch, and accessories compartment for battery, headphone, and the hank antenna.



# A HOME SECURITY RADIO

By
**H. G. BOURNE** and **E. J. CORDIER**
Ohio Department of Health

*A rugged, four-tube superhet which combines good sensitivity with long battery life—insuring reliable emergency service.*

"THE fear reaction of military personnel who were not acquainted with the technical details, atomic bomb, was appalling at Bikini and Eniwetok. The fear reaction of the uninitiated civilian is ever evident. It is of such magnitude that it could well interfere with an important military mission in time of war." So states the Army Medical Department in the publication "What You Should Know About the Atomic Bomb."

One of the major causes of panic is fear. Terror of the unknown promotes disorganized behavior. By predisaster education and training, the threat of unknown or fantastic dangers may be diminished. During the emergency or danger situation itself, and for several hours to a day or more thereafter, other factors such as rumor, suggestibility in contrast to critical judgment, imitative behavior (people run when others run), and tension and insecurity will continue to operate to produce panic.

Civil defense authorities may inform the individual, stimulate leadership, dispel fear, and explain the procedure one must follow to satisfy basic needs such as hunger and safety if a means is available for communication with each household. How can this panic-decreasing information be conveyed to the individual in the absence of telephone service and failure of conventional broadcast receivers subject to community electric service?

There are those who have counseled that aircraft, taxis, and police cars already equipped with radio receivers be provided with a public address system to soundcast information and instruction. Such a procedure limits the broadcast information to short disconnected phrases such as "Boil water!" "Stay indoors!" "Keep off the roads!" Such brief pronouncements containing a modicum of truth in the absence of explanation may be elaborated, distorted, misinterpreted, mangled, and constantly magnified with each retelling until they contribute to hysteria.

Moreover, loud noise as from a public address system may, in conjunction with other sounds, directly contribute to panic. Caldwell *et al*[1] state "In a disaster people may hear the loud noise, smell objects burning, and see people running. These sensory stimuli heighten excitement and contribute to panic behavior." Schmidberg[2] in describing British experience has stated "Auditory impressions in war exercise the strongest effect of all on nerves. The whistling of falling bombs, the sounds of their explosions, and the boom of the antiaircraft guns mingle in the inferno of noise wi shattering effects on the nerves."

Others have recommended batter operated portable broadcast-band r ceivers of the vacation type or aut mobile radios as a means of con municating with householders. In ea household, however, unless leadersh is maintained, the collective behavi of the group will be panic in type. ' maintain leadership, civil defense con munications affecting the family ur should be directed exclusively to t family head. This privacy of con munication is defeated by a speake equipped vacation or automobile r ceiver. Moreover, World War II r collections suggest in the event future conflicts the majority of vac tion receivers will be inoperative b cause batteries are unobtainable. A automobile receiver is a heavy dra on the car storage battery. And, dead battery is poor preparation f flight if evacuation is ordered. If t car engine is run to maintain the ba tery charge, the usual caution to avo running internal combustion engin in closed garages is likely to be d regarded in time of mental stress a more deaths can be anticipated fro carbon monoxide poisoning than liv saved by radio-acquired informatio Hence neither personal-type, batter operated radios nor the automob receiver provide a satisfactory so tion.

A special-purpose, home-secur radio of improved sensitivity a powered by a universally availa battery is proposed by the autho One receiver believed to be suita is described in the hope it may stim late further development and eventu commercial manufacture for pub service.

There are now available to the pu lic portable radios that are inexpens and of simple operation; such fe tures pose no special problem. Re

ity may be secured through the of quality components adequately tected from the destructive forces man and nature. Two features of emergency home receiver, how-r, require special study, *i.e.*, source power and sensitivity.

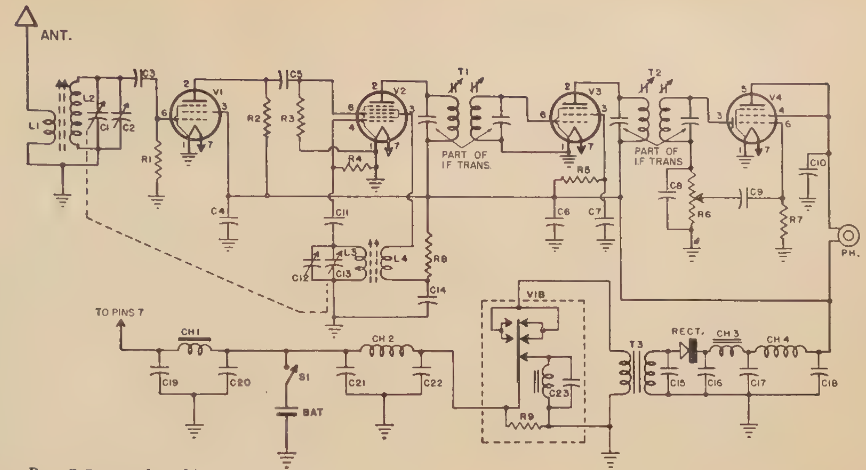
## Energy Source

The ideal source of energy for a ne-security receiver would be a gle battery of sufficient capacity d infinite shelf life which could be rgized by the addition of tap water urine. Furthermore it should be convenient size and weight, com-rcially available everywhere, low ed, and nonspillable. Since no such tery was known to the authors a gle No. 6 dry cell was selected as ompromise. The standard No. 6 dry l will deliver 80-90 per-cent of its ginal power when placed in use at end of one year and 50 per-cent n at the end of two years. It may replaced for less than $1.00 and erwise appears to satisfy the re-rements of an ideal battery.

The useful life of a No. 6 dry cell uld obviously be too brief to operate y radio expected by the public to vide entertainment; however, in the ent of disaster, a receiver would e emergency service if it was ca-ble of maintaining a schedule of 10 nutes "on," 20 minutes "off" for hours (daylight) and then after an ernight rest the same schedule re-ated for a total of three days. The wer pack was therefore designed to apt the energy from a single No. 6 y cell to the operation of a receiver three days on this timetable. It mained to construct a receiver to mbine minimum battery drain with gh sensitivity.

The circuit and components of a brator power supply which proved tisfactory are shown as part of Fig. Although commercially available rts were utilized wherever possible, was necessary to make special okes and to readjust the standard volt vibrator driver contacts to cure dependable starting and maxi-um output voltage and current when erating on 1.5 volts. If the vibrator ils to start on 1.5 volts or the "B" ltage is too low due to poor vibra-r action, open the vibrator by care-lly sawing around the can about ½" ove the base. Turn the driving con-ct adjustment screw until optimum eration is obtained. Replace the can d hold in place with plastic vinyl pe.

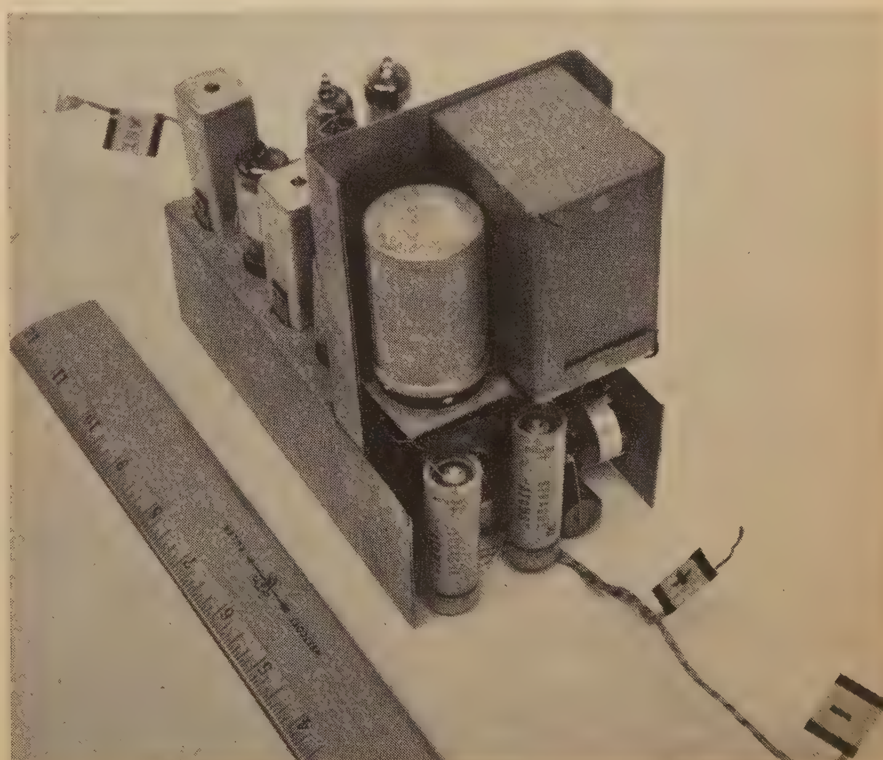
The audio frequency choke, $CH_1$, de-rves special attention. The core was at of a standard output transformer milar to that used as the vibrator tput transformer (*Knight* 8000/3 ms—*Allied* No. 62-093). Any small ansformer core will do. It is only ecessary to remove the "I" section of e core which opens the "E" section. he winding will then slip off easily. irst wrap one or two layers of vinyl astic tape on the core, then wind No. d.c.c. enameled wire about the cen-




*$R_1$—5.5 megohm, ½ w. res.*
*$R_2$—10,000 ohm, ½ w. res.*
*$R_3$, $R_7$—3.3 megohm, ½ w. res.*
*$R_4$—100,000 ohm, ½ w. res.*
*$R_5$—27,000 ohm, ½ w. res.*
*$R_6$—500,000 ohm pot with sw.*
*$R_8$—17,000 ohm, ½ w. res.*
*$R_9$—220 ohm, ½ w. res.*
*$C_1$, $C_{13}$—2-gang var. cond. 8.7-170.7 μμfd., 11-431 μμfd.*
*$C_2$, $C_{12}$—2-17 μμfd. trimmers (on $C_1$, $C_{13}$)*
*$C_3$, $C_5$, $C_{11}$—400 μμfd. mica cond.*
*$C_4$—.002 μfd., 600 v. cond.*
*$C_6$, $C_{14}$—.05 μfd., 400 v. cond.*
*$C_7$, $C_9$—.01 μfd., 600 v. cond.*
*$C_8$, $C_{23}$—.002 μfd. mica cond.*
*$C_{10}$—.005 μfd., 600 v. cond.*
*$C_{15}$—.003 μfd., 1600 v. cond.*
*$C_{16}$, $C_{17}$, $C_{18}$—10 μfd., 250 v. elec. cond.*
*$C_{19}$, $C_{20}$—500 μμfd., 6 v. elec. cond.*
*$C_{21}$, $C_{22}$—.5 μfd., 100 v. cond.*
*$L_1$-$L_2$—Adj. iron core ant. coil (Meissner #14-1071)*
*$L_3$-$L_4$—Adj. iron core osc. coil (Meissner #14-1074)*
*$T_1$, $T_2$—455 kc. iron core i.f. trans. (Meissner #16-6758)*
*$T_3$—Vibrator trans. 8000/3 ohms (Knight—Allied #62-093)*
*$CH_1$—32 mhy. audio freq. choke (see text)*
*$CH_2$—.3 mhy. r.f. choke. Closewind 3 layers, 15 t. each, No. 16 d.c.c. enameled wire on ¼" wood core. Held in place by black vinyl plastic tape*
*$CH_3$—1.5 hy., 10 ma. filter choke, 95 ohms res. (Merit C-2973)*
*$CH_4$—2.5 mhy., 50 ma. r.f. choke (National R-50)*
*VIB.—2 volt vibrator (Mallory type T-4003-2, Radiart 5469-2, or Allied 56-128. See text for modifications)*
*Rect.—35 ma. selenium rectifier (Sarkes Tarzian Type 35)*
*BAT.—No. 6 dry cell (see text)*
*PH—Single 1500 ohm headphone*
*$S_1$—S.p.s.t. interlock switch, normally closed. Wired in series with "on-off" sw. which is integral with volume control pot, $R_6$. $S_1$, closed when cover is open.*
*$V_1$, $V_3$—1U4 tube*
*$V_2$—1R5 tube*
*$V_4$—1S5 tube*

**Fig. 2. Complete schematic diagram of the battery-operated "security" radio receiver.**

**Fig. 3. Internal view showing vibrator power supply mounted on the vertical chassis and receiver proper located on the horizontal chassis. See text for details.**



ter leg until the "window" area is full. Replace the "I" section, being careful to make good contact with the "E" section. One must also exercise caution against shorting the wire to the core. The "I" and "E" sections are then held firmly in place by bending the mounting bracket lugs into their former position.

Upon completion of the receiver and its included power pack, trial runs were made to determine the plate potential and current as well as the battery terminal potential as the 10 minutes "on," 20 minutes "off" schedule progressed. After four days of operation the terminal potential of the No. 6 dry cell dropped to approximately 1.2 volts and the vibrator ceased to start.

## Sensitivity

The home security radio was designed upon the premise that it must receive, during daylight hours, stations 25 miles or more distant having 1000 watts or less power. Furthermore, the reception must be accomplished with no more antenna than could be located in a cellar or bomb shelter. These specifications are based upon the assumption that metropolitan and suburban transmitters will be silent following an attack for one or more of the following reasons: station destroyed, no power, personnel dead. Elsewhere, silence will be imposed for security reasons except for previously designated transmitters located in the nearest supporting communities. The power output of these outlying stations will be restricted to the minimum necessary to reach the devastated area effectively. Transmissions will proceed during daylight hours in order that the information broadcast can be converted by the family head into appropriate action.

A four-tube superheterodyne utilizing one stage of untuned r.f. amplification was found to be most capable of achieving high sensitivity with low battery drain, portability, operational simplicity, and moderate cost. A similar conclusion was arrived at by Passow[3] who also had the problem of obtaining more sensitivity from loop-operated receivers so that they could be used in isolated communities throughout the country rather than only in metropolitan areas.

## Portability and Cost

Sufficient portability to permit the receiver being easily moved from the owner's house to a neighbor's, to the automobile, bomb shelter, or garage is desirable. "Pocket size" is considered unnecessary since the family which may be required to evacuate its home will wisely choose to burden itself with no more than food, extra clothing, money, and valuable papers.

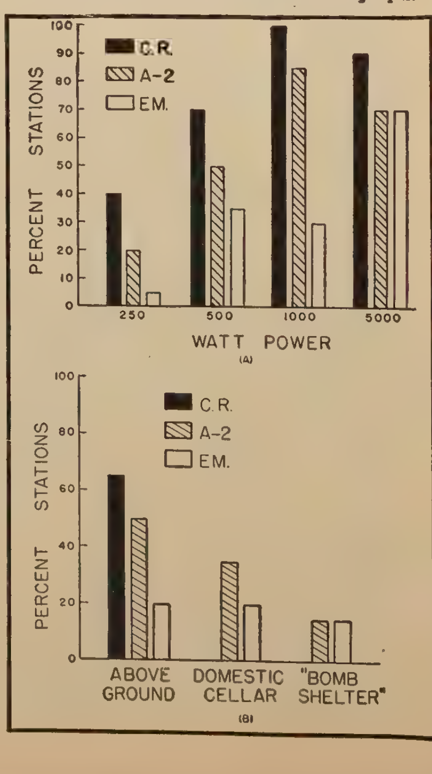
The total net retail cost of the components of the single receiver constructed was $42.50. Quantity buying, construction simplification, and manufacturing "know how" could be expected to reduce the cost very considerably. However, it is believed that it is far better that many foresighted families make a financial sacrifice to purchase an adequately built unit rather than to have every household be induced by cheapness to buy a worthless product.

## General Description

The receiver circuit is a standard superheterodyne employing a 1U4 in an untuned r.f. stage, a 1R5 as oscillator-mixer, another 1U4 in the i.f. stage and a 1S5 as diode-detector and audio-amplifier. Automatic volume control has been omitted and audio-amplification is limited to that of the 1S5 triode since its output is sufficient to operate the headphone. The untuned r.f. stage represents a compromise between the greater sensitivity of a tuned r.f. stage and the necessity of a large 3-gang condenser and other components which would have increased the size, weight, and cost of the receiver.

The chassis consists of two sections as may be seen in Fig. 3. The horizontal receiver member contains on the topside tubes, i.f. cans, and variable condenser while directly beneath are located the usual fixed condensers, resistors, tube sockets, volume control, safety switch, etc. The vertical power supply chassis is inset into and attached to the receiver unit. On the upper portion of the vertical chassis is mounted the vibrator and a mi[...] can containing the high voltage tran[...] former, rectifier, choke, and filter co[...] densers. Underneath are placed t[...] low voltage filtering chokes and hi[...] capacity condensers needed to remo[...] r.f. hash and audio-hum produced [...] the vibrator. This construction and t[...] use of steel chassis material was fou[...] necessary to reduce internal noises [...] an acceptable level.

**Fig. 4. (A) Comparative performance of a communications receiver (C.R.), the home security radio (A-2), and a commercial four-tube personal portable (E.M.). "Per-cent stations" represents the per-cent of b.c. stations within 100-mile radius of test locations which were received in each of four power classifications: 250, 500, 1000, and 5000 watts. (B) Similar comparison with b.c. stations of 1000 watts power or less made at three sites as indicated on graph.**




An external view of the comple[...] receiver is shown in Fig. 1. The stur[...] metal box housing the receiver [...] 10 5/16 inches high, 7 1/8 inches wide, 4[...] inches deep and is provided with tw[...] mounting ears and a carrying handl[...] The cover when closed and lock[...] insures against unwarranted use [...] the radio by inquisitive members [...] the family. The weight of the enti[...] receiver and accessories is 10 poun[...] 6 ounces.

Certain other external featur[...] merit special mention. An interlo[...] switch is provided which automatical[...] shuts off the battery when the cov[...] is closed. The battery is intentional[...] conspicuous to remind the set own[...] that it must be replaced periodical[...] and to facilitate its change. Moreov[...] since one instinctively associates [...] limited output with a single batter[...] its prominent location tends to temp[...] the receiver's use. A hank antenna [...] provided in place of the more usu[...] built-in loop to add a certain inco[...] venience to operation, thereby discou[...] aging the radio's use as a casu[...] "plaything." The large dial with ve[...] nier enables one to log stations a[...] curately in advance, thereby obviati[...] the necessity of station hunting du[...] ing an emergency.

## Performance

In the absence of suitable labor[...] tory equipment to measure absolu[...] sensitivity, it was necessary to reso[...] to a comparison method in order [...] evaluate the emergency receiver's pe[...] formance. In the first test the secu[...] ty receiver (A-2), with 25-foot ha[...] antenna placed in a horizontal po[...] tion six feet above ground, was co[...] pared for sensitivity with a comme[...] cial communications receiver (C.[...] employing a suitable outside do[...] blet antenna and with a commerc[...] four-tube personal portable ra[...] (E.M.) provided with the usual bu[...] in loop. To make this compariso[...] every broadcast station within a 1[...] mile radius of the test location w[...] noted and placed in one of four pow[...] groups: 250, 500, 1000, and 5000 wat[...] The number of stations in each pow[...] group which each of the three [...] ceivers was able to "bring in" duri[...] the daytime was recorded and the p[...] cent of the total in each power gro[...] calculated. The results are presen[...] in Fig. 4A. This bar graph shows t[...] the A-2 radio could receive consid[...] ably more stations than a commerc[...] four-tube vacation portable but l[...] than a commercial communicati[...] receiver having a sensitivity of [...]

(*Continued on page 107*)


Six-frequency crystal marker assembled from junk-box parts. The circuit will oscillate at almost any frequency. Over-all cost is low.

# A LOW-COST CRYSTAL CALIBRATOR

By G. L. COUNTRYMAN, W3HH

*Crystal calibrators can be expensive, but versatile junior models can be put together at surprisingly little expense.*

STAL calibrators for modern re- ivers are a "must," especially for eration on net frequencies, but dollars a copy, they become a y item. Their use is even more tant if older or more moderately receivers are used, as the cali- n of these sets is seldom too ate and varies as the compo- "age." Most receivers will drift l kilocycles in the first 20 or nutes and, if a schedule is to be on a spot frequency, it is nice able to come up "on the nose" if you have forgotten to warm e receiver in advance.

"calibrator" or marker unit by the author is constructed on all aluminum open-end chassis ong x 3½" wide x 2" high and ns six crystal sockets, four small for ½" holders and two for ¾" s. The tube is a 6V6, but any de or beam power tube, regular niniature, will be equally satis- y. No power supply is included ere is invariably a source of in the shack, and any receiver upply the low heater current and w ma. of high voltage required. he calibrator is to be used with RO, a unit with one crystal can uilt into a *Vector* C12-M #3 ture plug-in turret, using a 6AG5, or 6AK5 tube, and the turret ed into the calibrator socket of RO. One such unit is shown in hotograph on this page. With this of construction, turning the *HRO* to either the 100- or 1000- kc. on will operate the marker, as RO switch is in the high voltage lead. The heater supply and high voltage come from the *HRO*. Many receivers have an accessory socket from which power is available.

A simple, foolproof circuit is utilized, one that will oscillate with a crystal of any frequency. Your old friend, the modified Pierce with unnecessary "frills" removed, is shown in the schematic. If only one crystal is used, the socket can be wired in place and the selector switch eliminated. It is not too much trouble to plug in different crystals for different frequencies, anyway. A 100-kc. crystal makes it a true calibrator; other crystals provide calibrated marker points.

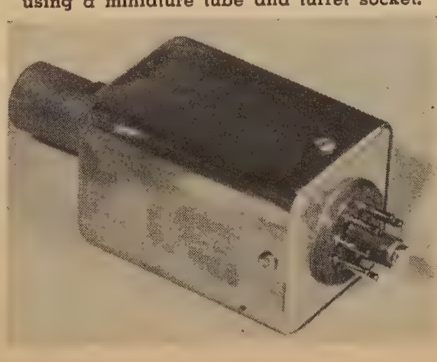
The cost is very close to the zero point. Most amateurs will have no difficulty in finding the required parts in their junk boxes: a small chassis, any convenient size; a pentode and socket; one or more crystals and sockets; two 50,000-ohm, ½-watt resistors; three mica or ceramic condensers, .01 and .001 μfd., and .0001 μfd.; a 2.5 mhy. r.f. choke; and a toggle switch are all the parts required. A 2-circuit, 6-position selector switch may be added for extra crystals. A one-watt dropping resistor may be needed if the "B-plus" supply is much higher than 150 volts.

That's all it takes! The high voltage lead in the author's copy was brought to a 2-terminal tie point so that the terminals could either be jumpered, or an appropriate series resistor added, depending on the high-voltage source to be used. With the present high voltage source (a 275-volt supply that operates the monitor) a 30,000 ohm, 1 watt resistor is used to keep the voltage down to the minimum required to insure stable oscillation of the crystal.

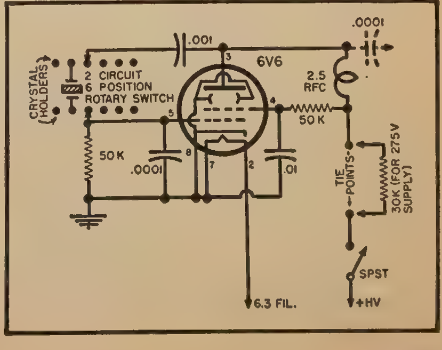
It is easy to begin. First look over your crystals, the lower the frequency

(*Continued on page* 133)

A one-crystal version, using same circuit but eliminating selector switch, was built using a miniature tube and turret socket.



Schematic of the low-cost calibrator. It will work with any common pentode, although 6V6 is shown. Receiver supplies the power.



# HIGH-QUALITY RECORD REPRODUCTION AT LOW COST

By **FRANCIS H. YONKER**
Electronics Lab., Pennsylvania State College

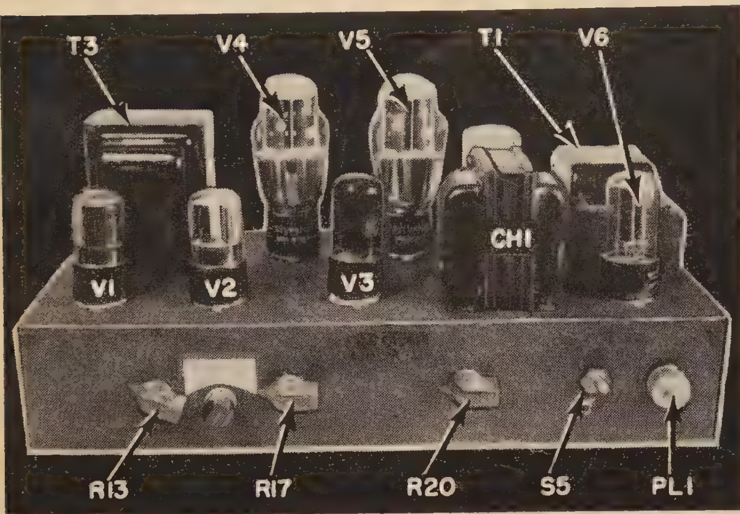



**Fig. 1. Over-all view of the home-built amplifier which was especially designed to handle various type phono pickups.**

*Construction data on a low-cost ampli*
*that will match variable reluctan*
*crystal, and Brush PL-20 type picku*

THE components sold for use in today's new high-fidelity circuits cost so much that the average experimenter or music lover can't afford the parts to build the equipment he has read about or seen. The twenty- to thirty-dollar output transformers and the one-hundred-dollar loudspeakers shoo the builder right back to his old equipment.

Fig. 2 is the schematic diagram of an audio amplifier that will match the hi-fi enthusiast's phono pickup whether it be the magnetic reluctance, regular crystal, or the old favorite *Brush* PL-20, which the author uses for 33⅓ rpm broadcast transcriptions.

The magnetic pickup preamplifier consists of $V_1$, the 6SL7 tube, and its component parts which form a circuit almost identical to the *General Electric* preamplifier. The required compensation for record equalization is built into this circuit but by varying the 6800 ohm input resistor to higher or lower values the frequency response will change.

The next input, "Crystal Pickup," is for those regular phono-arms found on the typical record player. By experimentation and curves obtained using the *RCA* constant tone record #84522-A, the equalizer consisting of a 5 megohm resistor and 67 μμfd. condenser was employed.

The final input, "*Brush* PL-20," was added because so many music lovers have proven in the past that this pickup and the 16-inch broadcast transcriptions equalized by the *Brush* filter cartridge, afford much enjoyment in the way of varied programs of radio broadcast recordings.

Each of these inputs is switched to the amplifier by the rotary switch $S_1$-$S_2$-$S_3$. The first half of $V_2$, 6SL7, is necessary for amplification of inputs except for the reluctance pickup, whose preamplifier output is sufficient to drive the second half of $V_2$ directly *via* the tone control circuit. The treble control, 100,000 ohms, and bass control, 200,000 ohms, with their associated condensers, introduce considerable loss but the preamplifiers have sufficient gain to overcome this attenuation.

The second half of $V_2$ is an ordinary amplifier with negative feedback incorporated by omitting the cathode by-pass condenser.

$V_3$, a 6N7, is a straight-through amplifier and phase inverter which also contains negative feedback of the same form described previously. The 6N7 tube characteristics allow a greater voltage swing output without distortion than other smaller tubes such as the 6SN7, and also allows operation on the more linear portion of its characteristic curve.

The push-pull output stage, consisting of two 6B4 tubes, gives that preferred triode low plate resistance with less distortion and smaller transformation ratio to the low loudspeaker impedance. The output transformer is a low-cost *Thordarson* 25-watt T-22S70 unit. The transformer does not have a flat response curve up to 20,000 cycles but why care too much about its high-frequency efficiency when adjustment of the tone controls will allow greater signal input to the output transformer at the "fall off" frequency to make up for the transformer loss.

The beauty of this amplifier lies in the availability of bass and treble tone control. Reference to Fig. 3A shows the actual frequency response when the controls are set as indicated.

It's possible to make the recor
sound like accentuation of high or
frequencies, complete loss of on
the other, or a combination near
middle range of controls allow
small adjustment to satisfy the
dividual ear. Any way, the next
low to hear your "set-up" is goin
like some other combination of
controls. Pointer knobs and dial pl
will aid in setting controls for e
reproduction of the many diffe
phonograph record characteristics

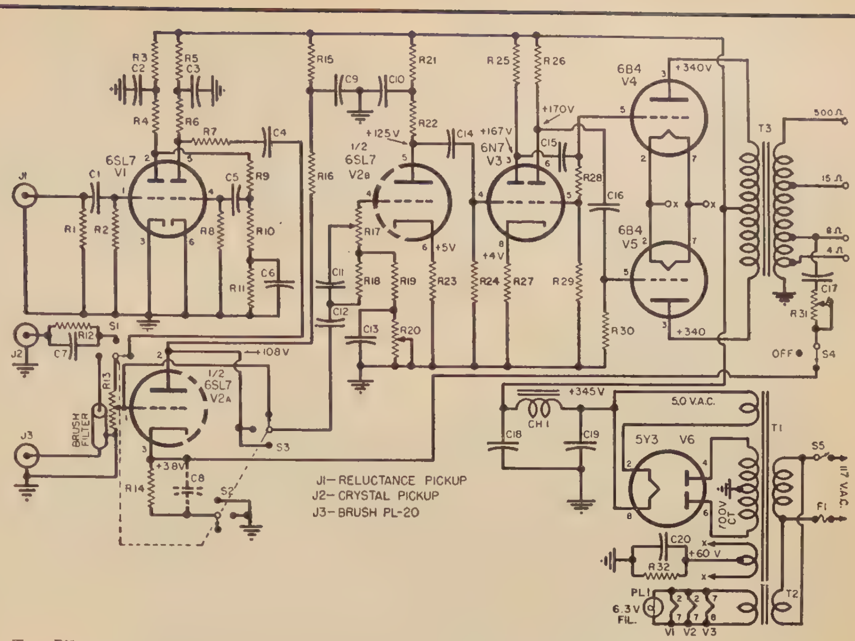
It's true one can make much r
elaborate amplifiers with switc
equalizers for every type recor
the market but since each indivi
likes music to suit his own tast
can be adjusted by this tone-co
combination to satisfy the condit

Switch $S_4$ is added for those
like to experiment with feed
voltage direct from the loudspe
winding. The frequency resp
curves of Fig. 3A and 3B were
tained with this feedback switc
the "Off" position. By adjusting
throughout its range, where osc
tion or motor-boating does not o
one will find much in the way of
entertainment by listening to
tone combinations that are produ

The builder used a 25-watt, 12-
speaker as a woofer and install
separate 5-inch tweeter directly a
it. The speaker combination
mounted in a bass reflex cabinet
to specifications given in "Data-
2" in the June 1952 issue of RAD
TELEVISION NEWS.

*EDITOR'S NOTE: In order to*
*the cost of this unit low, the au*
*has built a preamp, amplifier,*
*power supply on a single ch*
*Where cost is no object, readers*
*referred to "The* RADIO & TELEV
NEWS *Preamp" (Nov. 1952) and*
*proving the Williamson Ampli*
*(Feb. 1953) for circuits capable o*
*cellent performance.*

$R_1$—6800 ohm, 1/2 w. res.
$R_2$, $R_8$—3.3 megohm, 1/2 w. res.
$R_3$, $R_4$—68,000 ohm, 1 w. res.
$R_5$, $R_6$—33,000 ohm, 1 w. res.
$R_7$—68,000 ohm, 1/2 w. res.
$R_9$, $R_{11}$—180,000 ohm, 1/2 w. res.
$R_{10}$—27,000 ohm, 1/2 w. res.
$R_{12}$—5 megohm, 1/2 w. res.
$R_{13}$—2 megohm pot. ("Volume Control")
$R_{14}$, $R_{27}$—1500 ohm, 1 w. res.
$R_{15}$, $R_{21}$—22,000 ohm, 1 w. res.
$R_{16}$, $R_{22}$—56,000 ohm, 1 w. res.
$R_{17}$—100,000 ohm pot. ("Tone Control")
$R_{18}$—100.000 ohm, 1/2 w. res.
$R_{19}$—4700 ohm, 1/2 w. res.
$R_{20}$—200,000 ohm pot. ("Tone Control")
$R_{23}$—1800 ohm, 1 w. res.
$R_{24}$—270,000 ohm, 1/2 w. res.
$R_{25}$, $R_{26}$—130,000 ohm, 1 w. res.
$R_{28}$, $R_{30}$—240,000 ohm, 1/2 w. res.
$R_{29}$—10,000 ohm, 1/2 w. res.
$R_{31}$—50,000 ohm pot. ("Feedback Control")
$R_{32}$—750 ohm, 10 w. wirewound res.
$C_1$, $C_5$—.05 μfd., 400 v. cond.
$C_2$, $C_3$—.2 μfd., 600 v. cond.
$C_4$—.02 μfd., 400 v. cond.
$C_6$—.01 μfd., 400 v. cond.
$C_7$—67 μμfd. ceramic cond.
$C_8$—20 μfd., 25 v. elec. cond. (used only if feedback is eliminated)
$C_9$, $C_{10}$, $C_{12}$, $C_{13}$, $C_{14}$, $C_{15}$, $C_{16}$—.06 μfd., 600 v. cond.
$C_{11}$—124 μμfd. ceramic cond.
$C_{17}$—.25 μfd., 400 v. paper cond.
$C_{18}$, $C_{19}$—40 μfd., 450 v. elec. cond.
$C_{20}$—30 μfd., 150 v. elec. cond.
$T_1$—Power trans. 350-0-350 v. @ 200 ma.; 5 v. @ 3 amps.; 6.3 v. c.t. @ 6 amps. (Thordarson T-22R07 or equiv.)

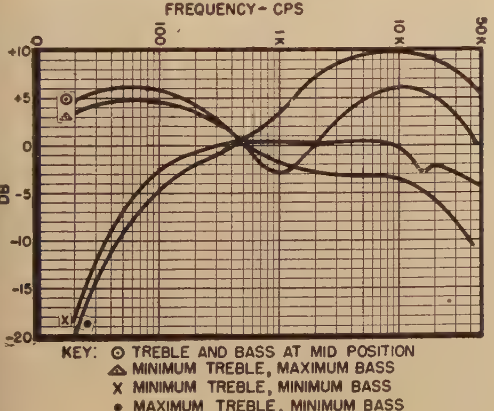



$T_2$—Fil. trans. 6.3 v. c.t. @ 3 amps. (Thordarson T-21F10 or equiv.) Ground one side of secondary.
$T_3$—Output trans. 5000 ohms plate-to-plate (Thordarson T-22S70 or equiv.)
$CH_1$—12 hy., 100 ma. filter choke (Thordarson T-20C53 or equiv.)
$F_1$—Line fuse
$S_1$-$S_2$-$S_3$—3-pole, 3-pos. rotary wafer switch
$S_4$—S.p.d.t. switch ("Feedback")
$S_5$—S.p.s.t. switch ("Power")
$PL_1$—6.3 v. pilot lamp
1—Brush filter unit (for Brush PL-20 pickup)
$J_1$, $J_2$, $J_3$—Closed circuit phono jack
$V_1$, $V_2$—6SL7 tube
$V_3$—6N7 tube
$V_4$, $V_5$—6B4 tube
$V_6$—5Y3 tube

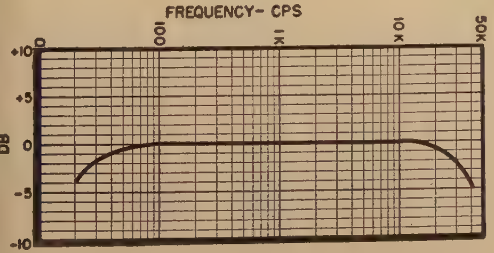
Fig. 2. Circuit diagram and parts list covering a low-cost audio amplifier which uses standard, easily-available components.

★

Fig. 3. (A) Amplifier response with various positions of tone controls. Note particularly that where "maximum" and "minimum" is shown reference is made to the physical position of tone controls and not to response. In operation there is an interaction between bass and treble circuits. (B) Over-all amplifier response with tone control circuit out. Input is at the crystal phono jack. Power output is 9.3 watts.




(A)




(B)

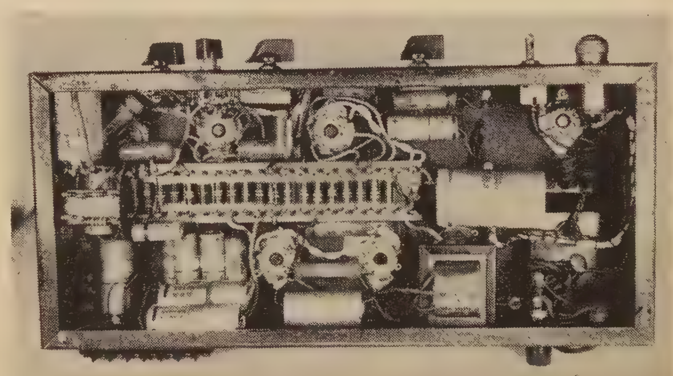
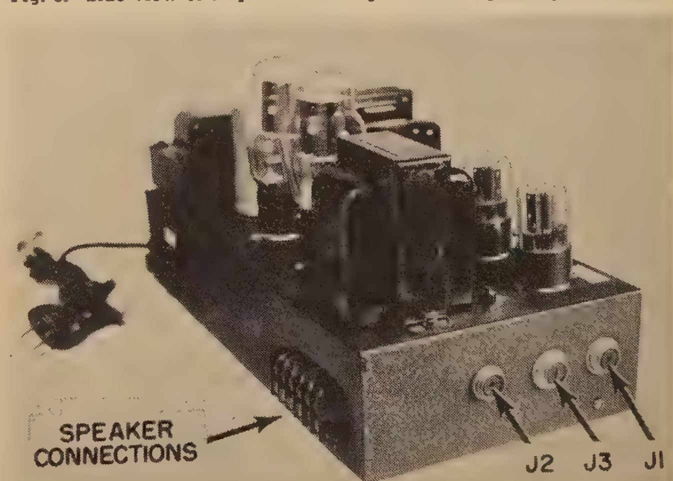


Fig. 4. Under chassis view shows terminal-board construction of unit.

Fig. 5. Side view of amplifier showing location of phono pickup jacks.



# MAC'S RADIO SERVICE SHOP

By JOHN T. FRYE

## THE FIELD STRENGTH METER

"THAT DOES IT!" Barney suddenly snapped as he threw down the tools he had been using in an attempt to adjust the linearity of a TV set. "I'm going to find what's causing that interference or know the reason why!"

Mac, his boss, cocked a sympathetic eye at the face of the picture tube. The test pattern on it was moving steadily downward. By adjusting the vertical hold control the boy could make the picture frame correctly for a few seconds at a time, and then a dark, inch-wide band of interference could be seen moving slowly from the bottom to the top of the pattern. When this line reached the top, however, it replaced the blanking bar there, and then the picture started sliding down again.

"It'll be a good trick—if you can do it," Mac commented skeptically. "That thing has been hanging around for two days now."

"Just watch Uncle Barney; he's got it all planned," the youth boasted.

He was already connecting a hot-shot battery to the inverter normally used in the service truck to supply small amounts of 117 volt a.c. from the car battery when needed. This combination went into a knapsack on his back. The leather shoulder strap of the shop's *Simpson* field strength meter was adjusted so that the meter was carried in front of him. This instrument was plugged into the inverter, and a folded dipole fashioned from twin-lead and supported on a T-frame made of plaster lath was connected to the meter's 300-ohm binding posts. A pair of phones on the boy's head was plugged into the jack of the field strength meter.

He switched on the instrument, carefully manipulated its fine-tuning control, and swished the probe antenna about as he listened intently.

"Contact!" he shouted triumphantly. "I can hear it fine, and it reads thirty microvolts on the meter. Open the back door and let old bring-em-back-alive-Barney out. If you don't hear from me in a couple of days you'd better send out a search party."

"I'll not wait that long," Mac shouted back so Barney could hear him with the phones on. "Neither your legs nor that hot-shot battery will last very long with the load they are carrying."

Barney sallied forth into the alley and Mac, still chuckling at the ludicrous figure his assistant made with all the paraphernalia, went back to the bench and picked up what Barney termed "Mac's idea of a thrilling whodunit book." It was Milton Kiver's *"TV Servicing Shortcuts"* and really was as fascinating to Mac as any collection of detective stories; for it was not made up of just rare service problems but was composed of actual cases encountered in routine servicing of a wide variety of sets. He became so engrossed in reading about the symptoms and then trying to guess the trouble before reading ahead to see if he was right or wrong that he did not note the passage of time. When he did look up it was to see the test pattern standing perfectly still with no sign of interference. At the same time there was a lusty kicking at the back door to indicate the interference sleuth had returned.

"Mission accomplished!" Barney announced triumphantly as soon as Mac opened the door. He lumbered inside and waved an old-fashioned sha pointed light globe under Mac's no "I just watched the meter and kept m ing toward where the antenna's dir tional pattern and the changing me reading pointed, and I walked ri up to this relic in a socket over loading platform down the all When I told the store owner about and offered to buy him a new b for this one, he said I was welco to it for it had been fouling up a ' set in the store for a couple of da too. Said he couldn't imagine wh the maintenance man ever found thing in the first place. Anyway, puts out a mean 5000 microvolts Channel 6 when you put the anten right up against it."

"Anyone comment on your appe ance?" Mac asked with a grin as helped Barney out of his rigging.

"No, but a gang of little boys ga me a hard time. They called 'Flash' and kept wanting to hear talk to my space ship. Finally I h to tell them that if they didn't scr I was going to melt them down w my atomic disintegrator pistol."

"Guess we've got to rack up other victory for the good old fi strength meter," Mac commented he fondly patted the gray enamel c of the instrument. "This thing h more uses than a piece of twine."

"Yet quite a few technicians try get along without one," Barn pointed out. "They argue that al field strength meter is good for is tell if a signal is coming down feed line and to help point the tenna at the station when you inst it. They say they can tell all t just by watching the set itself."

"Then they've got a better eye th I have. We found out from experie with the meter that as soon as you past 200 microvolts of signal it ta a tremendous increase to show m effect on the picture. The a.g.c. cuit does its best to hold the sig delivered to the picture tube at same value no matter how the sig at the antenna terminals changes. you line up an antenna with jus picture for an indicator, you get impression the main receiving lobe much, much wider than it really With the meter, since it responds the slightest change in signal streng you can point the antenna right the button. However, I'll not argu signal strength meter will do a lot jobs that cannot be done by any ot means; I'm simply convinced it d these jobs quicker, easier, and m accurately."

"Know what you mean," Bar agreed. "When I run up agains set with a normal raster but w weak picture and sound or none all, my first move is to hook field strength meter to the antenna a good signal is coming in, I kn I can concentrate on the set; if I know I'm in for some roof scamp ing. A funny thing, too, is how m that meter impresses the average tomer." (*Continued on page 1*

# ELECTRONICS FOR THE YACHTSMAN

By **HARRY R. ASHLEY**
Pres., Electronic Instrument Co., Inc. (Eico)

**...ver-all view of the motor yacht "Miss Eico" showing radio and ...V antennas and direction finder loop. Station WCBS' transmit-...ng tower at New Rochelle, N. Y. may be seen at right rear.**

*...d to the pleasure and safety of your cruises ... using modern marine electronic equipment.*

...HE longing which prompted Masefield to declaim "I ...nust go down to the sea again", has obviously gripped ...arge segments of the American populace as literally ...usands are joining the ranks of small boat owners ...h year. Whether the "sea" is the Atlantic Ocean, ...ke Michigan, or some quiet inland lake or riverway, ... lure is proving irresistible to many a weekday ...ndlubber".

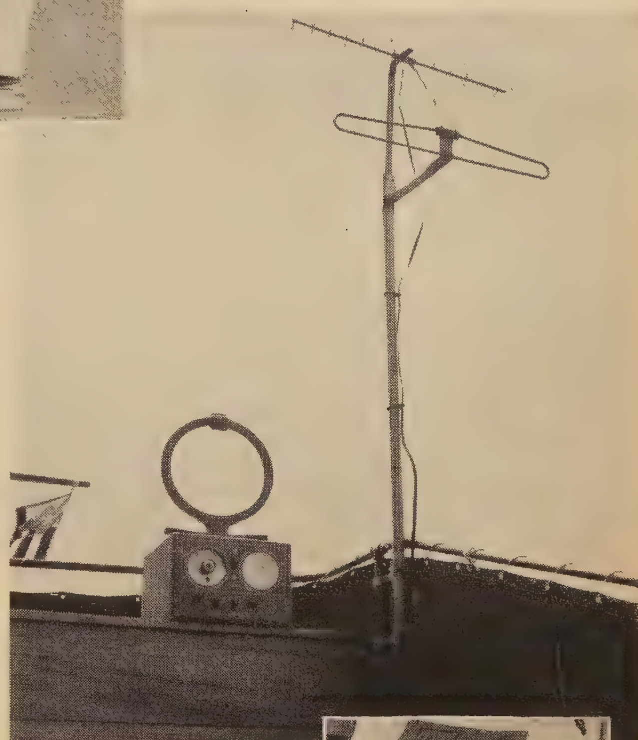
...he questions foremost in the minds of the average ...sent or prospective boat owners are what electronic ...ipment should I have and what will it cost? Since ... War, many marine electronic items have been made ...ailable to the small boat owner through simplification, ...niaturization, and price reduction. Today even the ...st modestly priced bottom can boast of a radio re-...ver capable of tuning the marine bands. From such ...nimal equipment the electronic gear a boat may carry ...l range all the way up to an elaborate installation ...rthy of an ocean-going liner.

...hould the boat be a small one which is to be operated ...clusively in charted channels or within sight of land, ...ctronic equipment is not essential. Any gear which is ...talled, however, adds to the operating convenience of ... craft but falls more or less into the "luxury" category.

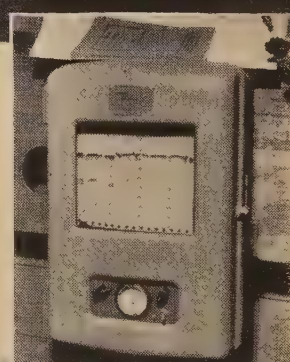
...or craft operating in open waters out of sight of ...d, a two-way radiotelephone is virtually a "must" for ... safety of those aboard. Radiotelephone can be readily ...d from any near-shore location and, should an emer-...ncy arise, the Coast Guard can be summoned. This ...ne equipment may be used for ship-to-ship contacts for ... friendly exchange of information ranging all the way ...m navigational tips to the latest dope on where the ...h are running. Because of the shared enthusiasm for ...ating, many friendships have been formed as a result ... such informal ship-to-ship radio contacts—reminiscent ... the friendships begun on the ham bands.

...f you are a good seaman, one that can navigate with ...nfidence by compass alone, perhaps you will not re-...ire the second piece of "must" equipment for the deep-...ter sailor. If, however, you are dubious about your ...amanship or will be navigating in totally unfamiliar ...ters, a radio direction finder is a handy item to have ...oard. Needless to say when the fog rolls in the direc-...n finder becomes the yachtsman's "best friend".

(*Continued on page* 108)

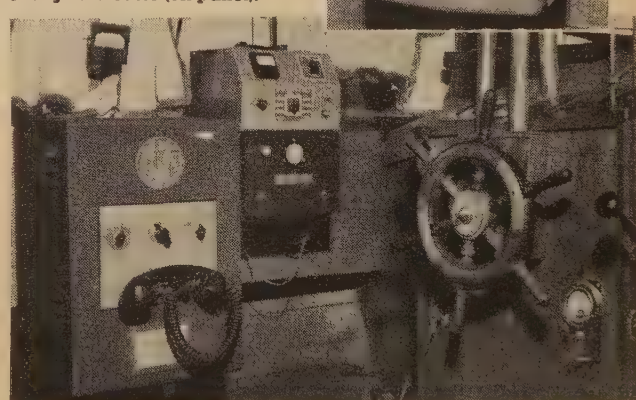


**The Bludworth Marine direction finder which covers beacon, broadcast, and marine bands for widest protection and surest results.**

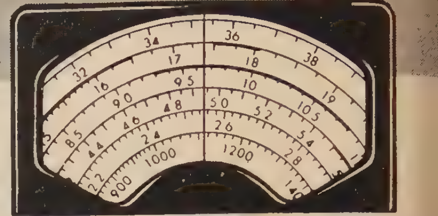


**Bendix recording depth finder aboard the "Miss Eico."**

**Jefferson Travis radiotelephone, Surrette battery charger, Eico battery eliminator and charger, transmitter output meter, and the charge indicator (on panel).**



# *International* SHORT-WAVE



**Compiled by KENNETH R. BOORD**

THE Japanese Standard Frequency Station, JJY, can be heard on 4.000 (error: $5x10^{-8}$) daily 1900-0900 and on 8.000 (error: $5x10^{-8}$) at 1600-0600; QSL's by card; QRA is Radio Regulatory Commission, Standard Frequency Section, Engineering and Monitoring Division, Minato-ku, Aoyama, Tokyo, Japan. (Ishikawa, Takemi, Japan)

* * *

## This Month's Schedules

*Albania—Radio Tirana* now operates on *announced* 6.570, 7.853 with *English* 1415, French 1330, German 1400, Italian 1315, 1500. (WRH)

*Anglo-Egyptian Sudan—Radio Omdurman* noted near 7.655 at 1330 with call, then talk or news in Arabic, followed by Arabic music. (Pearce, England)

*Angola*—Luanda, 9.472A, noted with music 1505; Portuguese announcements; weak to fair. (Cox, Dela.)

*Argentina*—LRY1, 9.760, Buenos Aires, noted mixing with TGWA, Guatemala, around 2350. (Cox, Dela.) Strong in Tokyo around 0600. (Ishikawa) *Radio El Mundo,* 6.120, heard 2000-2030, fair level; all-Spanish. (Borne, Sweden) LRA, 15.345, noted with news to North America 1815, strong. (Zerosh, Pa.)

*Australia — Radio Australia* has been moving around in its 0700-0845 beam to Eastern North America, due to QRM; by this time may be using 11.840 or may have moved to the 31-m. band (try 9.540 or 9.615). Dexter, Iowa, notes VLA15, 15.200, very good around 2200.

*Bolivia*—CP38, 9.497, La Paz, noted opening 2030 at good level. (Ferguson, N. C.) Heard opening 1756 with "Onward, Christian Soldiers." (Pearce, England)

*Borneo (USI)*—The Home Service of *Radio Republic Indonesia* is heard on 5.030 from Bandjermasin, with 1 kw., until 1030 closedown. (Japanese Short-Wave Club)

*Brazil — Radio Relogio Federal,* 4.905, Rio de Janeiro, noted 1730 relaying "A Voz do Brasil." (de Mesquita e Sousa, Portugal) ZYK2, 15.145, Recife, noted in Sweden 0930-1010 with QRK4 signal. (Borne) *Radio Tamoio,* ZYC8, 9.610, good level 1915-1930. (Oestreich, Wash. State)

*British Honduras — Radio Belize,* 4.950, noted with news 1800; identifying 2130, followed by commercials, then light music; has trouble with *Radio Dakar,* Fr. West Africa, prior to 1800. (Cox, Dela.)

*British New Guinea*—VLT6, 6.130, now used *exclusively* by Port Moresby, noted 0600 with ABC news relay. (Ferguson, N. C., others)

*Bulgaria—Radio Sofia,* 9.700, lately has had *English* 1800-1815. (Zerosh, Pa., others) Now has news for Europe 1500 and 1615 on 6.070, 7.671A. (Pearce, England)

*Cape Verde Islands*—Praia, 5.890A, noted daily 1530-1700. (de Mesquita e Sousa, Portugal)

*Ceylon*—Commercial Service, 15.120, noted opening 2030; BBC news relay 2100. (Ferguson, N. C., others) Good on 11.975 at 0830. (Riggs, Calif.) Noted parallel on 9.520 at 1000-1230 closedown. (Gay, Calif.)

*Chile*—CE766, *Radio Yungay,* Santiago, noted on 7.660 fair level 1550 with music. (Cox, Dela.) Schedule is 0630-0130. (WRH) *Radio Sociedad Nacional de Mineria* has been varying lately around 11.945-11.957; noted to around 2200. (Stark, Texas) Schedule is 0630-2300 and outlets are listed CE622, 6.220, 5 kw., and CE1198, 11.985, 2.5 kw. (WRH)

*Colombia*—A *new* station of *Radio Cadena Nacional* has been heard on *announced* 4.935 signing off between 2230-2300; HJFV, *Radio Neiva,* 4.855, is now on the air until 2300 weekdays, to *after* 0100 Sun. (Radio Sweden) HJFK, 6.098, Pereira, fair level 2010; slight QRM. (Norman, N. C.)

*Costa Rica*—TIHV, San Jose, is a *new* station heard on 6.008A; announces "Radio Cristal;" strong *after* 2230 when is in clear; suffers QRM earlier from HJCH, 6.009, and CJCX, Rome, and YSS on 6.010. (Robbins, Ind.)

*Cuba*—COCQ, Havana, is now using 9.675 on an irregular schedule (moved from 8.825). (Robbins, Ind.)

*Cyprus*—Sharq-al-Adna sent schedule of 2225-0130 daily, 0130-0330 Fri. and Sun., 0330-1500 daily on 635 kc., 6.1[illegible]0, 6.170, 6.790, 9.650, 11.720. (Scheiner, N. J.)

*Czechoslovakia*—Prague, 9.95, heard with *English* to North America 2300-2330A. (Hyson, Md., others)

*Denmark*—OZF, 9.52, Copenhagen, noted with improved signal in North American beams 2030-2130, 2200-23 (Jim Smith, Mich.; Saylor, V others)

(Note: Unless otherwise indicated, all time is expressed in American EST; add 5 hours for GCT. "News" refers to newscasts in the English language. In order to avoid confusion, the 24 hour clock has been used in designating the times of broadcasts. The hours from midnight until noon are shown as 0000 to 1200 while from 1 p.m. to midnight are shown as 1300 to 2400.)

The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given. "A" means frequency is approximate.

*Dominican Republic*—HI2A, Sa ago de los Caballeros, has moved fr 9.680 to 4.840; signal peaks in I around 2000, then fades to a lo level and mixes badly with YV Venezuela, same channel. (Robbins

*Dutch New Guinea — Radio N Guinea* soon is to be returned to B from Hollandia; will have a n studio, a 5 kw. transmitter. (NN others)

*Ecuador* — Summer schedule HCJB, Quito, includes *English* North America 2100-2400, 9.745, 11.9 15.115, and 2300-2400 also on 6. *English* to North and South Amer 0630-0730 on 9.745, 11.915; *English* Europe 1600-1700, 17.89, 15.115, 11.9 and 1700-1730, 17.89, 15.115; *Engl* to Pacific 0130-0500 on 15.115, 11.9 9.745; *off the air Mon.* (Mathe Ohio)

*Egypt*—Current schedule of Ca 11.815, is 1320-1600 (Sat., Sun. 1700); news 1330. (Bellington, N. others) Noted on 9.750 lately as ea as 1035 with call in Arabic. (Pea England) Heard on this channel 2 with Arabic Service in news Western music. (Sanderson, Austra and others.)

*Ethiopia—Radio Addis Ababa,* 040A, noted 1330 in *English.* (M N. Y.)

*Fiji*—Some months ago, the P and Telegraphs Department exp mented on 6.100 parallel with regu 5.995 at Suva; latter has ABC n relay 0400; operates around 0030-0 (Cushen, N. Z., others) More recen has *tested* on 3.980. (Radio Austra

*Finland*—Helsinki, 15.19, noted *English* around 1430-1440. (Gol Mass., others)

*France* — Paris noted opening French on 15.24 at 0730, excell level. (Golden, Mass.) Heard para on 9.55, 6.200 at 1745 tune-in v *Paris-Inter* session in French. ( lington, N. Y.) The *English* Servic Great Britain now is daily 0145 7.240, French Lesson; daily 1345 11.970, French Lesson; daily 1500-1 on 6.050 with varied programs; swers to listeners' letters Wed., S (Catch, England) Noted in Fre 1830-2000 on 9.680, 11.700. (Dex Iowa)

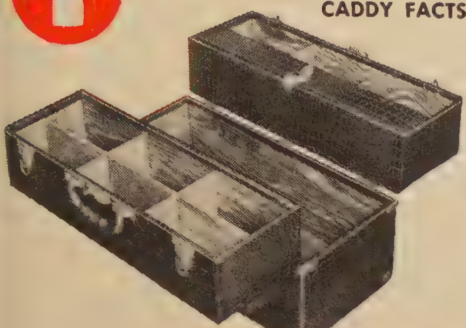
*French Equatorial Africa*—Bra ville, 9.44, 11.970, noted with n

(*Continued on page* 86)

# TAKE YOUR PICK

**THER OF THESE VALUABLE SERVICING ITEMS...YOURS AT O EXTRA COST...*with purchases of Federal Picture Tubes!***

## 1 THIS TOOL and TUBE CADDY or...



**CADDY FACTS:** An attractive convenience — for tools and tubes — you'll be proud to carry on all service calls.

Sturdy wood construction . . covered with simulated alligator leather (blue). Over-all size: 18¾ inches long, 13¼ inches high, 9 inches wide.

Brass-finished lock, hinges, catches and corner guards. Compartments hold approximately 75 receiving tubes of various sizes. Opens into three separate, easily-accessible sections. $9.50 value! (A $14.95 list value).

## 2 THIS 135-WATT WELLER SOLDERING GUN

**GUN FACTS:** Weller Model WD-135 (135 watts). Ideal for all types of soldering and dozens of household jobs.

Instant heating. Dual heat increases tip life. High or low heat as desired. Exclusive tip-fastening feature—full, constant heat. Low-cost, replaceable tips. Pre-focused spotlight. Longer reach—perfect balance. Shatter-proof plastic housing. $10.95 value! (A $14.90 list value).

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***Federal* PICTURE TUBES**


## How to get your choice—

With every purchase of a Federal "Best-in-Sight" Picture Tube, your participating Federal Distributor gives you one Federal Certificate. There are no restrictions on type of tube. You may buy one tube at a time, or as many as you need.

As soon as you have accumulated 10 certificates, deliver them to the distributor from whom you purchased your Federal Picture Tubes and he will exchange them for the Combination Tool and Tube Servicing Caddy OR the Weller Soldering Gun. (If you wish, both Caddy and Soldering Gun will be given in exchange for 20 Federal Certificates.)


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Federal's line of popular-size tubes will take care of over 0% of all TV replacements!

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# Technical BOOKS

"RADIOTRON DESIGNER'S HAN
BOOK" edited by F. Langford-Smi
Reproduced and distributed by t
*RCA Victor Division* of *Radio Cor*
*ration of America.* 1423 pages. Pr
$7.00. Fourth Edition.

Those who are familiar with t
earlier editions of this handbook w
be both surprised and pleased by t
encyclopedic proportions it has a
sumed in this newest and most co
plete version.

This well-known "bible" of the i
dustry is four times larger than t
Third Edition published in 1940, r
flecting the great strides made by t
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or so.

The text material is prepared wi
the engineer, student, and expe
menter in mind and covers thorough
the design of radio and audio circu
and equipment. The information
circuit design and application is p
sented not only mathematically b
practically so that those with limit
engineering experience can profit fr
the exposition. For the engineer w
wants to know "why" and "how" su
circuits function—that information
also provided.

The book itself is divided into sev
major sections and covers such top
as radio tubes; general theory a
components; audio frequencies; ra
frequencies; rectification, regulati
filtering, and hum; complete receive
and an impressive array of tabl
graphs, charts, bibliographies, ref
ences, etc.

For a compact and ready-referen
source of a veritable gold mine
pertinent information, this book w
be hard to beat.

* * *

"TV MANUFACTURERS' RECEIV
TROUBLE CURES" edited by Milton
Snitzer, Published by *John F. Ri*
*Publisher, Inc.*, New York. 113 pag
Price $1.80. Paper bound. Volume

This is the third in the curre
*Rider* series covering troubleshooti
procedures as developed by the
manufacturers themselves.

Service notes for receivers ma
factured by *Kaye-Halbert, Kent, M*
*navox, Majestic, Meck, Mercury, M*
*west, Montgomery Ward, Motoro*
*Muntz, National, North Americ*
*Philips, Olympic, Pacific Mercu*
*Packard-Bell,* and *Philco* have be
included in this volume.

The book is completely indexed
model numbers to permit the ra
location of the desired data. Sub
quent volumes will cover receivers
other companies.

* * *

"TV SWEEP ALIGNMENT TEC
NIQUES" by Art Liebscher. Publis
by *John F. Rider Publisher, Inc.*, N
York. 120 pages. Price $2.10. Pa
bound.

# Bring back that New-Set Sparkle with Performance-Tested Tubes

**Meet John Cunningham, a CBS-Hytron Commercial Engineer. John is beginning at the beginning for you. Socket by socket, he is analyzing the tube requirements of a brand-new TV set design.**

John knows the superior performance demanded. He concentrates his know-how on insuring top tube operation within standard specification limits. He tests sample tubes . . . checks analysis data. Working hand-in-glove with the set designer . . . and with CBS-Hytron engineers . . . he assures control of the characteristics of all tubes for this new chassis. Finally he achieves . . . from rectifiers to picture tube . . . the perfect performance all of this engineering team (and you) seek.

Constantly CBS-Hytron carries on teamwork like this. Socket by socket analysis. Day in, day out — with 9 out of 10 leading TV set makers. Both tube and set engineers pool their specialized skills. Scores of the nation's foremost TV set engineers help make endless CBS-Hytron improvements. Help assure you of unsurpassed performance in virtually *all* leading TV sets.

Small wonder that your CBS-Hytron replacement tubes recapture that new-set sparkle. Please *your* customers. Cut *your* call-backs. Profit more. Take advantage of CBS-Hytron engineering. Demand CBS-Hytron . . . your logical replacement tube, because it is performance-tested all the way . . . from original to replacement.

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***ALUMINIZED PICTURE TUBES***

**27EP4 and 24TP4 . . . both *mirror-backed, spherical, electromagnetic types.***

Leading TV set makers demanded maximum brightness from their large-screen sets. Without strain on component parts. For them, CBS-Hytron introduced its *Mirror-Back* picture tubes. Mirror-like effect of their aluminized backing steps up light output. Adds sparkling brilliance to the picture. Gives greater contrast and freedom from screen discoloration. You, too, will want CBS-Hytron *Mirror-Back* tubes for replacement. Because your customers can *see* them recapture that bright, new-set sparkle. Order the performance-tested 27EP4 and 24TP4 from your CBS-Hytron distributor.

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**RECEIVING . . . TRANSMITTING . . . SPECIAL-PURPOSE AND TV PICTURE TUBES • GERMANIUM DIODES AND TRANSISTORS**

This is a practical handbook for the television technician which is characterized by the common-sense approach which marks all of Mr. Liebscher's writings.

The book is divided into eleven main chapters and includes discussions of modern sweep alignment, sweep alignment techniques, markers, "supermark," sweep curves, tuner curve formation, i.f. alignment, i.f. curve adjustment, sound i.f. and sound detector alignment, video amplifier response testing, and u.h.f. sweep alignment.

The text material is lavishly illustrated with oscilloscope patterns showing the various circuit conditions encountered in television service work.

Both the practicing service technician and the student will find this little book a worthwhile adjunct to the servicing library.

* * *

**"UHF ANTENNAS, CONVERTERS, AND TUNERS"** by Milton S. Kiver, Published by *Howard W. Sams & Co., Inc.*, Indianapolis, Ind. 134 pages. Price $1.50. Paper bound.

As more and more television stations take to the air in the u.h.f. band, more and more service technicians are encountering problems heretofore unheard of in their experience.

To cope with these new and unfamiliar problems, Mr. Kiver has written this down-to-earth book to answer just such questions. The book is divided into five sections and deals in detail with such subjects as u.h.f. antennas, transmission lines and matching networks, u.h.f. installation tices, u.h.f. converters, and tuners.

The material presented is sp and to the point. Similarities an ferences between v.h.f. and u.h.f tems are pointed out where comparisons serve to advanc understanding of circuit oper Photographs, drawings, graphs, sketches have been used lavish amplify the text material.

Mr. Kiver's style is familiar readers of this magazine so it come as no surprise to them to that this book is in the same co clear-cut form as his articles, should provide the technician w lot of much-needed and auth data on u.h.f.

—30—

## AMATEUR EXTRA CLAS

**FCC has announced that radio timers" applying for the Extra amateur radio license may submi waiver of some of the requireme "Certificate of Skill" issued by th Department of Commerce and Lab fore June 30, 1913. Heretofore been necessary for an applicant se a waiver to show evidence of poss of an actual amateur license l April, 1917. It is necessary, wher mitting a "Certificate of Skill' fo purpose, to supply evidence of ownership or operation of an actual teur station before June 30, 1913 tails are in the Commission's Safet Special Radio Services Bureau Bu No. 2, available from FCC, Washi 25, D. C.**

—30—

**Stromberg-Carlson Company's Sound Division at Rochester, N. Y. has placed in ope tion a new 2½ ton magnetizing unit on its loudspeaker assembly line. The new elec magnet was designed especially for magnetizing the 10½ pound piece of Alnico V t serves as the permanent magnet in the company's 15 inch high-fidelity speakers. T magnetizing unit consists of a steel yoke, supporting the two pole pieces, each o foot in diameter. Each of the pole pieces is wound with three coils. There are proximately 700 pounds of copper in the coils. The complete assembly wei slightly over 5000 pounds. The photoelectric cell which controls the magnetizer activated by the loudspeaker passing through the light beam on the slowly moving b**

## Six-Meter Transceiver

(*Continued from page* 58)

ly 3½" over-all, which contributes much to a neat finished appearance. The transceiver is built as two small subassemblies which are completely wired before mounting within the "Minibox." Aluminum sheet salvaged from old transcriptions was folded to form the two chassis bases. A flat mounting plate with lips serves for the receiver and audio section, with the tubes and audio transformers mounted below the plate. The transmitter r.f. section required a step-shaped chassis to position the tubes and coil forms properly. The layout of components for these two units has to be carefully correlated so that the sections will interlace when fitted into the "Minibox."

The control switches should be mounted on the "Minibox" panel with suitable lengths of wire soldered to them before the two subassemblies are bolted in place in one corner of the box. The interconnecting wiring can then be completed, and the end support plate attached to form the battery compartment. This space measures just under 4" x 6" to provide room for two 90-volt "B" batteries in parallel, together with three 1½-volt flashlight cells which are connected in parallel for the "A" supply.

### Operation and Adjustment

The initial tune-up of the transmitter is most easily done with the aid of a grid-dip meter. The oscillator slug should be detuned slightly from resonance so that the circuit will be sure to oscillate whenever power is applied. The multiplier tanks are tuned for peak output. The "Minibox" cover has some detuning effect on the coils, so optimum adjustments are best made with this cover in place. Small ¼" holes drilled in the cover to give access to the slugs from outside can be neatly covered by hole plugs when not in use.

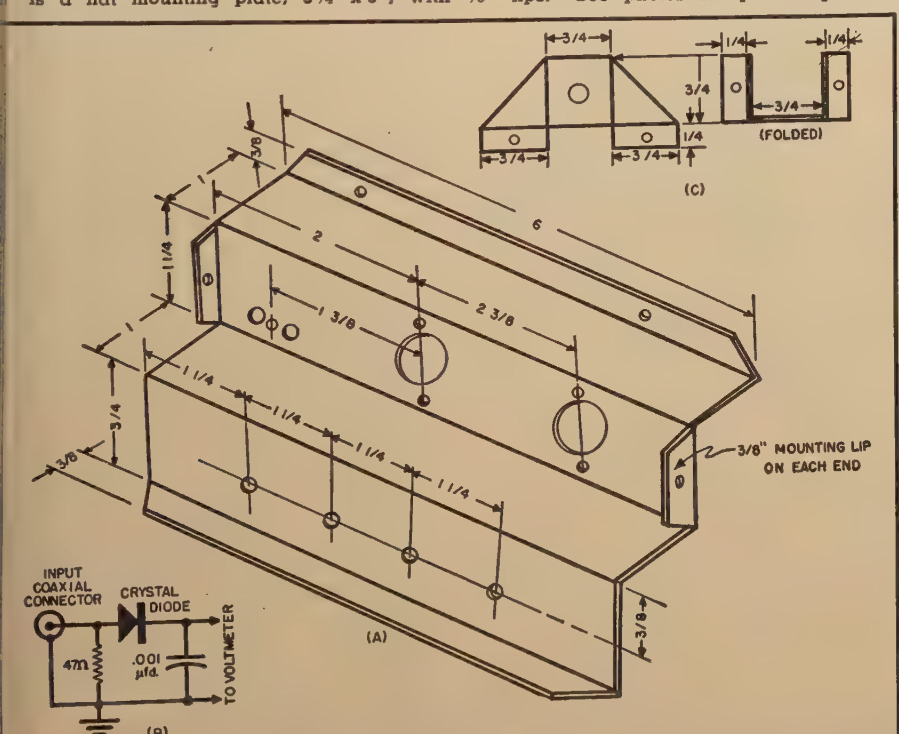
A communications receiver "S" meter, or a voltmeter connected to the suggested dummy load will make a handy output indicator for the tuning adjustments.

The detector slug, accessible through the front panel hole, can be adjusted by listening to a received signal. Since the operation is on a fixed frequency, the tuning adjustment will hold for long periods.

As would be expected, the useful range of the transceiver is limited by the signal-to-noise ratio of the receiver, so antenna efficiency plays a major part in the performance. Center- and top-loaded verticals were found to be less satisfactory than a quarter-wave whip for portable operation. A three-section collapsible auto radio whip fitted to a coax connector has proved to be a very serviceable antenna.

Any simulated ground plane or counterpoise will increase the antenna effectiveness. The range can, therefore, be increased by placing the transceiver on top of a car or other metal surface. In some applications a low-channel TV antenna can be used with excellent results. When used in a car, the regular 55" broad-

**(A) Details of the transmitter chassis, bent up from sheet aluminum. (B) A dummy load for tuning the transmitter. (C) Details of the receiver coil mounting bracket. Its position can be seen in receiver bottom-view photograph. Receiver chassis is a flat mounting plate, 3¼" x 6", with ⅜" lips. See photos for parts layout.**



cast receiver antenna gives a fin
account of itself.

The range between transceivers i
naturally affected by intervening ter
rain. Transmissions of a mile or s
can be expected over good paths whe
the units are hand-held, with corre
spondingly greater coverage when bet
ter antenna systems are used. —30—



## Anti-Flutter Circuit

(*Continued from page* 39)

a diode a.g.c. circuit, direct-couple video amplifier, and cathode drive t the picture tube. Its modification i more complicated. See Fig. 4. Th 470k resistor and parallel condense are removed and replaced by th anti-flutter network shown in Fig 4B. The resistance values in th network are modified as one of th steps to restore the picture tube cath ode potential to its original value an the condensers are changed to main tain the proper time constants wit the new resistance values. A resist ance-capacitance low-frequency com pensation network is added in th plate circuit as the second step i restoring the picture tube cathod potential and also to boost the trans mission of the video signal d.c. com ponent to approximately 100%, as suming a picture tube cathode inpu resistance of 50,000 ohms.

### REFERENCES


1. *Billin, J. J.: "Anti-Flutter Circuit," Journal of the Television Society, October December 1952.*
2. *British Patent 648,537.* —30—






## INTERNATIONAL CONTACTS

**UNITED STATES radio amateurs ar reminded that communication be tween amateur stations licensed by th Federal Communications Commissio and foreign amateur stations is permis sible subject to the limitations of Sectio 1 of Article 42 of the Radio Regulation annexed to the International Telecom munications Convention (Atlantic Cit 1947). Section 1 of this Article pro vides as follows:**

**"Radiocommunications between ama teur stations of different countries sha be forbidden if the Administration o one of the countries concerned has not fied that it objects to such radiocommu nications."**

**Information available through Apr 16, 1953, indicates that the followin countries have forbidden radio commu nication between their amateur station and amateur stations of other countries Austria, Cambodia, Indonesia, Iran (a amateur operation forbidden), Kore Laos, Thailand, and Viet Nam.**

**Amateur stations in Australia are au thorized to conduct radiocommunicatio for purely experimental purposes wit amateur stations in other countries, th administrations of which permit suc radiocommunication.**

**Amateur service has not yet been o ganized in Jordan and Rumania.**

**This information does not modif the handling of third-party communic tions by amateurs as outlined in th Commission's Public Notice of April 1 1952.** —30—

# MODERNIZE YOUR AM-FM TUNER


By **LT. COL. BYRON E. HARGROVE**
Signal Liaison Officer
TRADS, Fort Eustis, Va.


*Pep up those older model AM/FM tuners by making a few easy circuit changes and substituting newer and hotter tubes.*

MANY FM-AM enthusiasts purchased sets as soon as they were available after World War II. Although many have given excellent service through the years, almost all of them are performing considerably below what could be expected of them.

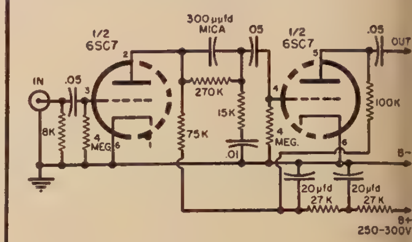
The modernization of a *Meissner* Model 2961 is described. Some, or all, of the changes described can be applied profitably to most FM-AM receivers.

The *Meissner* Model 2961 is a 29 tube FM-AM-phono combination with completely independent FM and AM tuners, but a common power supply and audio system. It was equipped with a phono unit having a crystal pickup and compensating preamplifier.

The audio system uses four 6L6 tubes, triode connected, in push-pull parallel as output tubes. Original specifications called for substantially flat response between 60 and 20,000 cps. Since the speaker with which this unit is equipped is capable of good reproduction of considerably lower frequencies, all audio coupling condensers in the main audio unit were replaced with .1 μfd., 600 volt units. Low frequency response was considerably improved by this change.

To obtain better record reproduction, the crystal pickup was replaced with a *G-E* reluctance unit. This necessitated replacement of the original preamp stage using a 9002 triode, with a 6SC7 preamp stage. The 6SC7 tube was mounted in the same position as the original preamplifier by removing the miniature socket, reaming the hole, and mounting an octal socket. See diagram Fig. 1.

In the FM unit, the 6AG5 r.f. tube and the three 6AG5 i.f. tubes are replaced by 6CB6 tubes, a newer, hotter




*1—8000 ohm, ½ w. res.*
*2—4 megohm, ½ w. res.*
*1—270,000 ohm, ½ w. res.*
*1—75,000 ohm, 1 w. res.*
*1—15,000 ohm, ½ w. res.*
*1—100,000 ohm, 1 w. res.*
*2—27,000 ohm, 1 w. res.*
*1—.05 μfd., 400 v. cond.*
*1—300 μμfd., 500 v. mica cond.*
*2—.05 μfd., 600 v. cond.*
*1—.01 μfd., 500 v. mica cond.*
*2—20 μfd., 450 v. elec. cond.*

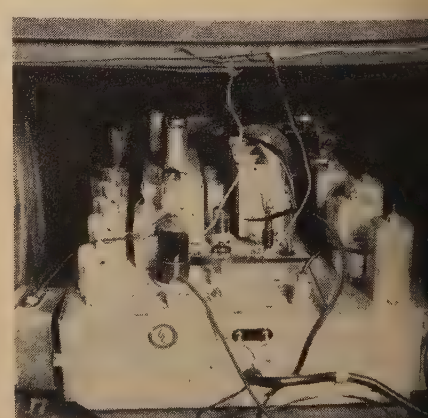
**Fig. 1. Preamp circuit added to permit us of the G-E variable reluctance pickup uni**

type. No circuit changes are require except to connect pins 2 and 7 togethe at each tube socket concerned.

Re-alignment of the set will be re quired. While the use of a sweep gen erator and oscilloscope is preferred, thoroughly satisfactory job can be don with nothing more than a good FM sta tion within comparatively short range

Tune the set to the high frequenc portion of the FM band to a poin where no station is being received. Be ginning with the i.f. transformer near est the discriminator (not the discrimi nator transformer), and progressin toward the "front end", adjust all i. transformers for maximum noise out put. (Better relations with the wif and other members of the family wi be maintained if this is done when yo

**Rear view of the author's "modernized" FM tuner. At the extreme left is the Drake 300-ohm hi-pass filter. The glass tube above the "UL" stamp on the chassis is the 6SC7 preamplifier with aluminum foil wrapped around it. This is not necessary if a metal tube is used. To the rear of the 6SC7 and above it is the 6AB4 grounded-grid r.f. stage mounted on aluminum bracket. Behind this is the original FM tuner. To the right of the tuner is the AM r.f. mixer and oscillator tubes. In front of the AM tuning condenser is the new "Ferri-Loop" antenna. The 300-ohm ribbon to this antenna connects one side of the original loop antenna to top of "Ferri-Loop." The two hook-up wires from top of cabinet are built-in antennas, one for push-button tuner and the other for reception on the shortwave bands.**



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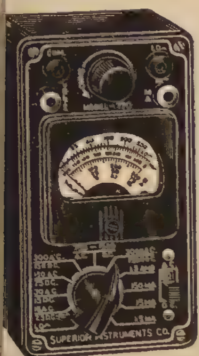
## uperior's New Model 770 VOLT-OHM MILLIAMMETER




***Sensitivity—1000 ohms per volt***

Uses latest design 2% accurate 1 Mil. D'Arsonval type meter. • Same zero adjustment holds for both resistance ranges. It is not necessary to readjust when switching from one resistance range to another. This is an important time-saving feature never before included in a V.O.M. in this price range. • Housed in round-cornered, molded case. • Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use.

**SPECIFICATIONS:**

**6 A.C. VOLTAGE RANGES:** 0-15/30/150/300/1500/3000 Volts.
**6 D.C. VOLTAGE RANGES:** 0-7.5/15/75/150/750/1500 Volts.
**4 D.C. CURRENT RANGES:** 0-1.5/15/150 MA. 0-1.5 Amps.
**2 RESISTANCE RANGES:** 0-500 Ohms. 0-1 Megohm.

Model 770 is an accurate pocket-size V.O.M. Measures only 3⅛"x 5⅞"x2¼".

**$14.90 NET**

**The Model 770 comes complete with self-contained batteries, test leads and all operating instructions.**

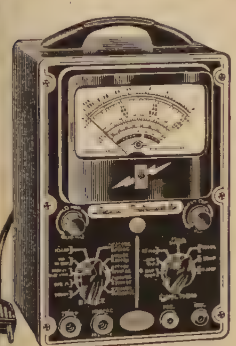
## Superior's New Model TV-11 TUBE TESTER

• Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary. • Uses no combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket. • Free-moving built-in roll chart provides complete data for all tubes. • Phono jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose external connections.

Operates on 105-130 Volt 60 Cycles A.C. Hand-rubbed oak cabinet complete with portable cover ............

**$47.50 NET**

## uperior's New Model 670-A SUPER-METER



**A *COMBINATION* VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS**

**SPECIFICATIONS:**

**D.C. VOLTS:** 0 to 7.5/15/75/150/750/1,500/7,500 Volts.
**A.C. VOLTS:** 0 to 15/30/150/300/1,500/3,000 Volts
**OUTPUT VOLTS:** 0 to 15/30/150/300/1,500/3,000 Volts
**D.C. CURRENT:** 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
**RESISTANCE:** 0 to 1,000/100,000 Ohms 0 to 10 Megohms
**CAPACITY:** .001 to 1 Mfd. 1 to 50 Mfd. (Quality test for electrolytics)
**REACTANCE:** 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms
**INDUCTANCE:** .15 to 7 Henries 7 to 7,000 Henries
**DECIBELS:** —6 to +18 +14 to +38 +34 to +58

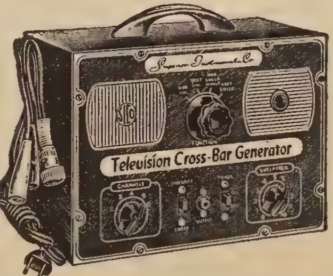
omes housed in rugged, rackle-finished steel cabinet complete with test leads and operating instructions. Size 6¼"x9½"x4½".

**$28.40 NET**

**ADDED FEATURE:**
**The Model 670-A includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.**

## Superior's New TV BAR GENERATOR

**THROWS AN ACTUAL BAR PATTERN ON ANY TV RECEIVER SCREEN!!**




**CONNECTS DIRECT TO ANTENNA POST**

**NO CONNECTION INSIDE RECEIVER**

**Features.**—Can be used when no stations are on the air. • Provides linear patterns to adjust vertical and horizontal linearity • Provides vertical and horizontal sweep signals • Provides signal for testing video amplifiers.

TV Bar Generator comes complete with shielded leads and detailed operating instructions ..................Only

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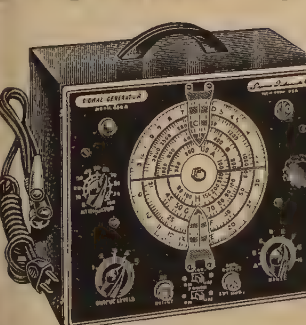

***Provides Complete Coverage for A.M.—F.M. and TV Alignment***

• Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 220 Megacycles on powerful harmonics. • Accuracy and stability are assured by the use of permeability trimmed Hi-Q coils. • R. F. available separately or modulated by the internal audio oscillator. • Built in 400 cycle sine wave audio oscillator used to modulate the R. F. signal also available separately for audio testing of receivers, amplifiers, hard of hearing aids, etc. • R. F. Oscillator Circuit: A high transconductance heptode is used as an R. F. oscillator, mixer and amplifier. Modulation is effected by electron coupling in the mixer section thus isolating the oscillator from load changes and affording high stability. • A. F. Oscillator Circuit: A high transconductance heptode connected as a high-mu triode is used as an audio oscillator in a high-C Colpitts Circuit. The output (over 1 Volt) is nearly pure sine wave. • Attenuator: A 5 step ladder type of attenuator is used.

• Tubes used: 1—6BE6 as R. F. Oscillator, mixer and amplifier. 1—6BE6 as Audio Oscillator. 1—6H6 as Power Rectifier. The Model 660-A comes complete with coaxial cable test lead and instructions .......NET

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Please send me the units checked below. I am enclosing the down payment with order and agree to pay the monthly balance as shown. It is understood there will be no carrying, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

☐ **MODEL 770** ........................................Total Price $14.90
$2.90 down payment. Balance $2.00 monthly for 6 months.

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$7.40 down payment. Balance $3.50 monthly for 6 months.

☐ **TELEVISION BAR GENERATOR**........................Total Price $39.95
$9.95 down payment. Balance $5.00 monthly for 6 months.

☐ **MODEL 660-A** ........................................Total Price $42.95
$12.95 down payment. Balance $5.00 monthly for 6 months.

☐ I enclose $........................ as down payment.

☐ Ship C.O.D. for the down payment.

Signature........................................

Name ........................................

Address ........................................

City.................................... Zone...... State......................

are the sole occupant of the house.)

After completing the i.f. alignment, align the 1st detector or converter stage and the r.f. stage in that order, again tuning for maximum noise. The FM antenna to be used should be connected before aligning the r.f. stage.

Now tune in an FM station. Identify it and check the frequency. Adjust the oscillator trimmer, if necessary, to bring it on frequency. If you are lucky, the quality should be OK. However, if distortion is present, adjust the discriminator transformer for best audio quality.

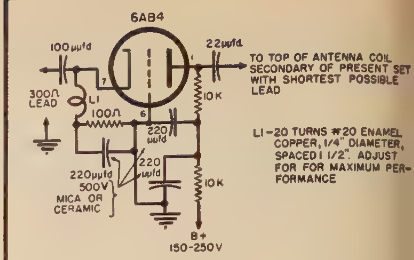
It should be possible now to obtain considerably improved FM reception. Further worthwhile improvement can be obtained by adding a grounded-grid triode r.f. amplifier. This stage is broadly tuned to the FM band and no additional controls are required. The r.f. stage should be mounted on a bracket as close as practicable to the existing r.f. stage. No shielding is necessary and if the set has been free from amateur radio and other interference previously, none should be present after the stage is installed.

"B+" for the 6AB4 grounded-grid r.f. amplifier should be taken from the "B+" lead for the r.f. or i.f. tubes in the original receiver. This will insure a well filtered, correct voltage for this stage. Heater voltage (for pins 3 and 4) may be obtained from any i.f. or r.f. socket.

The output from the r.f. amplifier is fed through a 22 µµfd. condenser directly to the "hot" end of the original antenna coil by means of the shortest lead possible. Use insulated hook-up wire, not shielded wire.

Now turn on the set and re-align the original r.f. amplifier for maximum noise output. The noise output will be increased slightly, since a grounded-grid triode amplifier introduces little noise, but the receiver sensitivity should be up materially.

With the completion of the above changes, the number of usable FM stations should be vastly increased.




*1—100 ohm, ½ w. res.*
*2—10,000 ohm, ½ w. res.*
*1—100 µµfd., 500 v. mica or ceramic cond.*
*3—220 µµfd., 500 v. mica or ceramic cond.*
*1—22 µµfd., 500 v. mica or ceramic cond.*
*Note: Output from 6AB4 connects to grid of previous r.f. amplifier (if included, if not, to grid of mixer). Use unshielded hook-up wire and keep as short as possible.*

**Fig. 2. Adding a grounded-grid triode r.f. amplifier to Meissner Model 2961 radio.**

Now to tackle the AM portion of th
set. Disconnect the lead from the an
tenna coil to the tuning condense
Mount a "Ferri-Loop" (one of the ne
compact antennas) above the chass
and close to the tuning condense
Ground one side of the "Ferri-Loop
and connect the other lead to the var
able condenser. Remove the small wi
attached to the "Ferri-Loop" and con
nect one side of the original loop an
tenna to the point where this sma
wire was attached. Leave the othe
lead from the loop antenna discon
nected.

Now tune the set to about 1000 k
and adjust the "Ferri-Loop" for max
mum signal response. The *Meissne*
uses 9003 tubes as the r.f. amplifie
and in the two i.f. stages. Replacin
these with 6BJ6 tubes will raise th
performance considerably. No circu
changes are required other than con
necting together pins 2 and 7 on th
sockets concerned.

After installing the new tubes, r
align the set. Performance on AM, FM
and phono should be much better no
than when the set was new. Total cos
if all parts are purchased new, shoul
be approximately $25.00 —30—

**Visitors to Electronic Wholesalers, Inc.'s recent "High Fidelity Music Festival" were able to see and compare a wide variety of audio equipment at this Sound Sales Salon set up in the Emerald Room of the Hotel Burlington in downtown Washington. The 45-day event drew thousands of interested spectators, attesting to the ever-increasing popularity of high quality home sound systems. Because of this wide-spread interest, the company has recently opened a new downtown Sound Sales Salon.**

# HINTS and KINKS for MOBILEERS

By JACK NAJORK, W2HNH

*These simple antenna tricks and a painless addition to the receiver will add greatly to the enjoyment of mobile QSO's.*

MANY articles on center- and base-loaded mobile antennas have pointed out that an antenna of this type must be accurately pruned to resonance at the operating frequency if it is to accept power and do a good job of radiating. If the ham is fortunate enough to own a grid-dip meter, finding the resonant frequency of the antenna is a simple matter.

Without such an instrument, determination of antenna frequency can become quite a problem, especially if a loading coil of unknown inductance is used with a whip whose capacity is also a matter of speculation. Starting with such a combination, it is often found that the resonant frequency of the system may be a half megacycle or more removed from the desired frequency.

The approximate resonant frequency of a new or experimental antenna of this type can be found very easily (and inexpensively) by a method filched from the broadcast antenna engineers*, which makes use of an ordinary buzzer and a calibrated receiver. The whip is grounded and the buzzer is loosely coupled to it, as shown in Fig. 1A. The resulting shock excitation of the system radiates a signal which peaks up sharply at the resonant frequency of the antenna. The station receiver is used to find this frequency and the system can then be pruned to the desired channel.

This method really works very well, the buzzer radiation showing a peak about 30 kc. wide which can be detected at a distance of twenty to thirty feet from the antenna with the average communications receiver. The higher the *"Q"* of the antenna being excited, the sharper will be the noise peak.

It is best to make the test at a time when the frequencies involved are relatively quiet, otherwise strong QRM may mask the noise peak. To prevent detuning, short leads should be used at the base of the antenna. An extra two inches in the form of a single-turn loop will provide sufficient coupling.

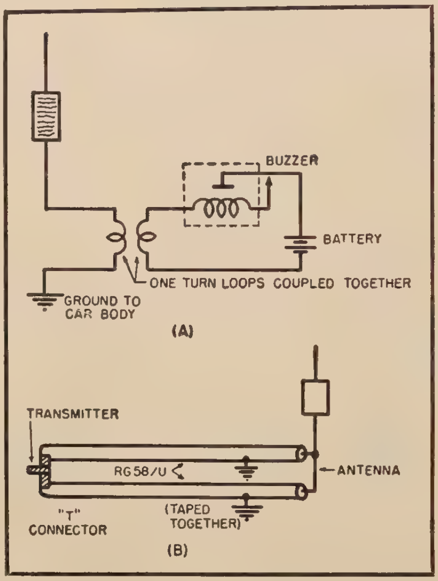



**Fig. 1. (A) Method of using a buzzer to determine resonant frequency of a mobile antenna. (B) The use of paralleled 52-ohm coax cables to improve impedance match.**

## Feeding the Loaded Whip

*Antennascope* measurements on a number of base- and centerloaded 75 meter whips show that the base impedance of these systems is very close to 25 ohms. Although 52-ohm coax can be used as a feed line, a much better match can be obtained by using two sections of small diameter RG-58/U (53.5 ohms) in parallel.

A neat job can be done by taping the two sections of line together and using a "T" coax fitting at the transmitter end, as shown in Fig. 1B.

* Henney, Keith: "Radio Engineering Handbook" (4th Rev. Ed.), chap. 14, p. 613.

## Improving Receiver Selectivity

The usual converter-car receiver combination used for mobile reception leaves much to be desired from the standpoint of selectivity, especially on the lower frequency bands where considerable activity is encountered. Aside from the common deficiency of poor station separation, the poor selectivity causes loss of gain on weaker signals, because a.v.c. action on a strong adjacent carrier decreases the sensitivity of the receiver over a relatively broad spectrum. Since adjacent-channel attenuation is primarily a function of the i.f. bandwidth in the car receiver, considerable improvement can be made by sharpening the skirt selectivity in the i.f. amplifier in "Q-5'er" fashion by the insertion of additional tuned circuits.

Such a modification is not nearly as complicated as it sounds or looks, and it will be found that quite a few of the modern automobile receivers now have ample room for the additional components required.

Fig. 2 shows the circuit added to a 1950 *Philco* receiver in the author's *Studebaker*. Two additional midget i.f. cans (four tuned circuits) were added between the mixer and i.f. amplifier tubes, together with a 6BJ6 amplifier tube. There was sufficient room inside the set to mount these components alongside the i.f. amplifier stage without crowding.

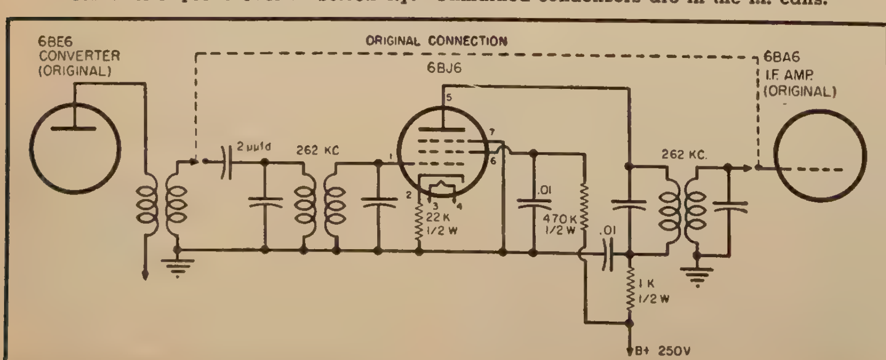
With the circuit values shown (262 kc. i.f.) the gain of the 6BJ6 stage is held down to 1.5 times because all that is desired here is sufficient amplification to make up for the insertion loss of the additional transformers. It is necessary that the suppressor of the 6BJ6 be grounded rather than being connected in usual fashion to the cathode. With the high value of cathode resistance used, the tube cut off completely until this change was made. Total cathode current of the 6BJ6 is less than two milliamperes, and the heater current was gotten "for free" by disconnecting one of the two dial lamps.

You will have to take the usual precautions in installing the extra stage to avoid oscillation in the i.f. system of the set.

After the modification is made, a complete i.f. alignment (preferably visual alignment with a sweep generator and scope) should be carried out. When you put the set back in operation you will find that you can sneak up a lot closer to the strong ones to copy those "S3" signals that were formerly "snowed under." The additional stage gives a healthy improvement with practically no increase in power consumption.

—30—

**Fig. 2. Circuit diagram of an additional i.f. stage for the car's broadcast receiver to improve over-all selectivity. Unmarked condensers are in the i.f. cans.**



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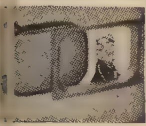
## FRINGE AREA TV RECEPTION IS BETTER WITH OUR McMURDO SILVER TV BOOSTER $10.95—TWO FOR $20.00

Read the article on pages 52 and 53 of the December "Radio & TV News." You will see how a booster like the McMurdo Silver Super Sonic was used for fringe area TV reception. We can't guarantee this unusual reception, but we will guarantee this booster to be a sensational value. Continuously variable inductance type tuner from channel 2 including the FM band through channel 13. Self-powered for 110 volts AC operation. Incorporates a 6J6 tube. Input for 300 ohm TV line and 300 ohm output to TV set. Single knob tuning. Attractive plastic case. McMurdo Silver Super Sonic TV-FM booster. Stock No. GB-6B, shipping weight 5 lbs. Sale price, **$10.95** each or two for **$20.00.**

## 14-Inch Conversion Kit WITH G.E. TUBE $25.95



14-inch conversion kit: You get a 14-inch black face, 1 year guarantee G.E. 14CP4 picture tube, a 70° deflection yoke with matching 14,000 volt G.E. flyback and a 14" plexiglas gold trim safety mask, plus conversion instructions. Stock No. 14CC-G, Sale price, $25.95.

## 3-TUBE SARKES-TARZIAN T.V. TUNER $9.95

This popular Sarkes-Tarzian Type 3 tuner is widely used. 13 channel rotary type switch with individually tuned coils. Price is complete with diagram and three tubes: 6C4 osc., 6BH6 R.F. and 6AG5 mixer. Regular factory cost is twice our price. Each tuner is wired ready to hook up to a video and sound IF strip. May be used with either inter-carrier or separate sound IF circuits. Has built-on convertor coil, built in fine frequency control. Sarkes-Tarzian TV tuner, with 3 tubes. Net price, **$9.95** each. Specify shaft length, either 2⅞" or 4¾".

## ...ICH CONVERSION KIT $25.95

...ch conversion kit with a 17BP4A, ...rectangular blackface electro-magnetic ... picture tube with 6 months' guaran... ...lus a matched 70° cosine yoke, a G.E. ..., 14,000 volt flyback and a 17" rec... ...lar gold trimmed plexiglas mask and ... shield. Suggested diagram furnished. ...ing weight, 30 lbs. via Express or ... only. Stock No. 17-4XL, 17" con... ...n kit. Sale price, **$25.95.** Kit Price ...GE or Raytheon 1 year guarantee pic... ...tube, **$5.00** extra.

## 20-Inch Conversion Kit $29.95

Our 20" conversion kit includes a 6-month guaranteed 20HP4, 20" rectangular blackface picture tube, plus a 14,000 volt G.E. built high voltage flyback transformer, plus a matched 70° cosine yoke, plus a 20" rectangular gold trimmed plexiglas mask and suggested diagram. The picture tube is the latest electro-static focus type that requires no focus coil. Shipped via express or truck only. Ship. weight, 40 lbs. Stock No. 20-TP, net price, **$29.95.** Price with Raytheon or GE 1 year guarantee picture tube, **$10.00** extra.

## 50-WATT BOOSTER AMPLIFIER

### 50-WATT BOOSTER AMP. $39.95

**2-Mike Pre-Amp $12.95 Extra. Not a Kit, but a Manufactured Amp.**

**50-WATT BOOSTER** A sensational value, 50 watt booster amplifier with push-pull parallel 6L6 output tubes. Connect to your present amplifier as a booster or use with the PR-2X Pre-amp to add the use of 2 mikes and one low level input. The booster amplifier has one input jack and with 1 volt input gives 50 watts of audio. Booster has a 6 lb. potted case high fidelity output transformer, matches speaker with 4-8-16 ohm voice coil, also 60 ohm and 250 ohm line. Booster has a 225 mill power supply with 5U4 rectifier. Price includes tubes: 4 6L6, 7N7 and 5U4. The two variable controls are for master volume control and bass boost tone control. Size 8 x 6½ x 14½. Stock No. PA-55N. Shipping weight 26 lbs. Sale price **$39.95 ea.**

**2-MIKE PRE-AMP.** Pre-amplifier plugs in directly to the PA-55N Booster amplifier. It enables use of 2. Crystal or Dynamic Mikes plus one low level input. Furnished with 4 foot cables and plugs for remote control of the 55 watt Booster Amplifier. Small chassis size 5 x 3¼ x 4". Stock No. PR-2X, with tubes 7F7 and 7N7. Net price **$12.95** ea.

## SPEAKER AND BAFFLE SALE

### 8" SPEAKER AND BAFFLE $4.95

Stock No. 818, Tan leatherette covered, plywood slant type wall baffle: plus an 8" Oxford, 2.15 oz. Alnico 5 magnet PM speaker. A red hot McGee special for only **$4.95** each, or **$4.70** each in lots of 3 or more.

### ... SPEAKER AND BAFFLE $6.95

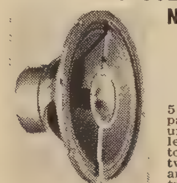
... No. CA-10. Tan leatherette covered ...ood slant type wall baffle; plus 10" ...anux. 3.16 oz. Alnico V PM speaker. ...a few hundred to sell at **$6.50** each, ...**6.25** each in lots of 3 or more.

### 12" SPEAKER AND BAFFLE $7.95

Stock No. CA-12. Tan leatherette covered plywood slant type wall baffle; plus a 12" Quam. 4.64 oz. Alnico V magnet PM speaker. (Popular Adjustacone model.) A terrific McGee value for only **$7.95** each, or **$7.50** each in lots of 3 or more.

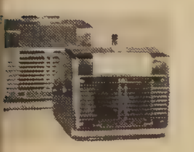
## McGEE'S $62.50 LIST 15" COAXIAL SPEAKER, $23.95

### New 1953 Model—21 Oz. Alnico V Magnet—5" Tweeter



This is the finest 15" coaxial PM speaker value that we have ever offered. New 1953 production, of a famous manufacturer of fine speakers. The 15" speaker has a 21½ oz. Alnico V magnet; equal to 68 oz. of the Alnico 3 type magnet. The cone is free floating, of one piece construction. Will reproduce low frequencies down to 20 cps. The 5" tweeter is coaxially suspended and has a ridged cone to reproduce only the high frequencies. It will respond up to 17,500 cps. The high-pass filter is concealed under the pot cover, leaving only two wires to connect both the tweeter and woofer to any 8 ohm output transformer of a radio, or high fidelity music lover's amplifier. Stock No. P-15CS, shipping weight 13 lbs. Net price **$23.95.**

## ... STATION INTERCOM MASTER $16.95 SUB STATION $3.95



3-station intercom master housed in chrome plated metal cabinet 7½"x6"x5" sloping front. Full 3-tube amplifier for 110 volt AC-DC operation. Press-to-talk switch is on top of the cabinet and volume control with off-on switch and station selector switch are on either side. May be used with from one to 3 sub-stations. (See matching cabinet chrome plated sub-station No. PM-A5.) Master is quiet at all times except when press-to-talk switch is pressed at the master or call-back switch is pressed at the sub. Uses 3-wire intercom cable. 3-station intercom master MPM-A3, shipping weight 10 lbs. Sale price, **$16.95** each, sub-stations extra. 3-wire plastic intercom cable. 100 ft. for **$1.95.** 500 ft. for **$8.95.**

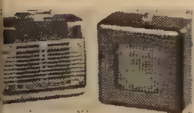
## 12" COAXIAL SPEAKER, $12.95

McGee offers the new 1953 model 12" coaxial PM speaker. Quality you would put in your finest sets if you were a manufacturer. 12" woofer has 6.8 oz. Alnico V magnet. Tweeter is coaxially suspended and has a metal diffuser. High pass filter is under the pot cover. Only two wires to connect to your radio or audio amplifier. 8 ohm with 18 watt peak and 10 watt average. Shipping weight 8 lbs. Response from 30 to 17,500 cps. Stock No. CU-14Y, Sale price **$12.95** each; 2 for **$25.00.**

## 12" JENSEN PM, $15.95

Another McGee Scoop! Jensen Concert 12", 14½ oz. Alnico V magnet PM speaker. 8 ohm voice coil. Will take 25 watt audio. You save dollars on this speaker. Just 100 to sell. Shipping weight 8 lbs. Stock No. P-12P, Sale price **$15.95**; 2 for **$30.00.**

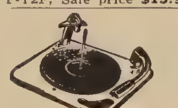
## ...00 INTERCOM SUB-STATIONS TO SELL AT $3.95 EACH



Chrome plated, with call back switch for a 3-wire intercom master. Size 7½"x6"x5" sloping front. 5" Alnico V PM spkr. Intercom dealers buy at less than present production costs. Limited quantity. Stock No. PM-A5, ship. weight 8 lbs. Sale price, **$3.95** each or 3 for **$10.00.** Special 3-wire plastic intercom cable. 100 ft. **$1.95,** 500 ft. for **$8.95.** Brown leatherette covered intercom sub-station with call back switch for use with 3-wire intercom masters. 5" square and 2½" deep. Has new plastic grill cloth, Alnico V PM speaker. A true McGee value. Stock No. NE-5, ship. weight, 1½ lbs. Sale price **$3.95** each or 3 for **$10.00.** 3-wire plastic intercom cable, 100 ft. for **$1.95,** 500 ft. for **$8.95.**

## G.I. 3-SPEED CHANGER WITH G.E. $22.95

### VARIABLE RELUCTANCE TURN-ABOUT CARTRIDGE



Another tremendous McGee Scoop! Brand new General Instrument 3-speed automatic record changers. Complete with RPX-050 G.E. variable reluctance cartridge with turn-about stylus. Plays all 3 speeds automatically: 7", 10" or 12" records. Has reject button. Repeats last record. Base size, 12"x12⅞". Shipping weight 14 lbs. Stock No. 700-GE. Scoop price, **$22.95.**

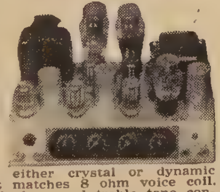
GI 3-speed changer same as above, but with Webster flip-over twin needle cartridge. Stock No. GI-700, Sale price, **$21.95** each.

# COMPLETE RADIO, TELEVISION AND AMPLIFIER KITS AT McGEE

## 3-WAY PORTABLE KIT $15.95

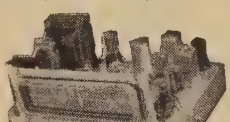
New 1952 Model 3-way personal portable radio kit. Operates on 110 Volts AC-DC or 67½ B ... 1½ volt self-contained batteries. ...erette covered case size, 5½x5¾x8". ...ves broadcast 550 to 1650 KC. A ...entional 2-gang superhet circuit with ... KC iron core IF's. Incorporates the ... super gain stick loop antenna. All ...d chassis. Lab. approved circuit—...hed parts. Price includes all parts, ...s, diagram, Alnico V PM speaker. A ...ry quality kit. Stock No. PN-4T, ship... weight 7 lbs. The complete kit. Less ...eries, **$15.95.** 67½V. B, **$1.59;** 1½V. ...9c extra.

## 8-Tube Hi-Fi Amplifier Kit $29.95



A complete kit, including tubes: 3-7E5, 2-12AX7, 2-triode plus rectifier diagram and photos. Inputs for radio tuner and any kind of phono pickup (crystal or G.E. variable reluctance) and either crystal or dynamic mike. Output matches 8 ohm voice coil. Twin electronic bass and treble tone controls with range selector switch for either juke box quality with heavy bass response or brilliant symphonic range. Response 18 to 20,000 cps. 8 tube all triode amplifier kit, complete with tubes. Shipping weight 25 lbs. Model 7X5. Net **$29.95.**

## 10-TUBE RADIO KIT $29.95



10 tube broadcast radio chassis kit, complete with tubes: 2-6SK7, 6SA7, 3-6SN7, 1-6SL7, 2-6V6 plus 5Y3 rectifier, diagram and instructions. 3 gang superhet with 8" slide rule dial. Chassis size, 12½"x10"x6½" high. Features push-pull 6V6 high fidelity audio. Output matches 3 to 8 ohm voice coil speakers. Inputs for G.E. variable reluctance or crystal phono pickup and crystal mike. Heavy duty power transformer. Model BK-R10 kit less speaker, shipping weight 18 lbs. Net **$29.95.**

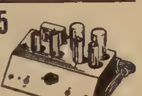
## 6-TUBE 2-BAND KIT $14.95

Popular with schools and colleges for training. 6 tube AC-DC. 2 band radio kit with plastic cabinet. Receives broadcast and 6 to 18 mc shortwave. Full 2 gang superhet with 5" speaker and slide rule dial. A complete kit with tubes: 12SK7, 12K8, 12SK7, 12SQ7, 50L6 and 35Z5, diagram and instructions. Factory quality. Cabinet size 13"x6¾"x6¼". Shipping weight 12 lbs. Model ME6-2, Net **$14.95.**

## 5-TUBE AC-DC KIT $12.95

Model RS-5. A 5 tube AC-DC straight broadcast kit, housed in the same cabinet as ME6-2 above. Complete with tubes. Shipping weight 10 lbs.. Net **$12.95.**

## ...d Your Own ...hono-Mike ...oadcaster $7.95



...Model DE-6R. With ... simple kit, you can ... a 3-tube phono ...lator that also has ...ike input. Will ...dcast over any ra... ...within your home, (about 75 feet) from ...0 to 1500 kc. Inputs for crystal mike or ...al phono pickup. Fader control fades ... mike to record. Ideal for a home P.A. ...em, baby listener and home entertain...t. A complete kit of parts including ...es. Kit Model DE-6R. Net price, **$7.95.** ...BRWT, wired and tested. Net price, ...**5.** Crystal mike and desk stand, **$4.95** ...a. Concealed microphone unit, only 1" ...iameter and ¼" thick. Specify hidden ... when ordering. Stock No. T-001. Net, ...5 extra.

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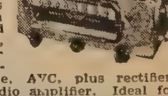
## 17, 20" T.V. Kit $59.95 Less Tubes

A complete kit of parts to build an AC transformer operated television chassis for use with a 16", 17" or 20" rectangular picture tube. The 12 channel Sarkes-Tarzian tuner is ready wired, as is the 4 tube video IF strip. Circuit is of the conventional design. Do not buy this unless you understand Television. It is difficult to wire. We furnish schematic. Kit model WH-20. Ship. wt. 40 lbs. less all tubes. Net **$59.95.** Cascode tuner $10.00 extra! 12" speaker **$2.95** extra. Kit of 22 tubes, less picture tube **$16.95.** 17" 17BP4A, **$19.95.** 20HP4, **$25.00.**

## AC POWERED BROADCAST TUNER KIT $12.95



A self-powered, 3-gang superhet tuner kit with R.F. stage. This complete kit is furnished with a diagram, photos and tubes. 6BA6 R.F., 6BE6 oscillator R.F., 6BA6 I.F. detector, 6AL5 diode, AVC, plus rectifier. Connect to any audio amplifier. Ideal for use with our S-2020 or 7x5 amplifier kits. Chassis size, 9½x4x4½" high. Shipping weight, 7 lbs. Broadcast tuner kit Model BT-38X. Net price, **$12.95.**

## McGEE RADIO COMPANY

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## International Short-Wave

(*Continued from page* 68)

1745-1800 closing. (Roberts, Conn others) Good with news on thes channels. (MacIndoe, N. J.)

*Germany*—Overseas Service fron Cologne noted on 11.795 at 1400 t Africa; signed off with German, *Eng lish* announcements 1547. (Pearce England) Heard on 6.270 at 0045 t North Africa. (Sanderson) Surprising ly good signal heard on 7.290 aroun 2130; news in German 0015-0025 (Lerch, Mass.) Has Mailbag Program Mon. 1400, 1800 on 11.795; 2130 o 6.270, 7.290; Tue. 0630 on 15.275, 103 on 11.795. Correct reports will be veri fied by *new* card. The "Staatliche Rundunkomitee" in the Russian Zon operates Berlin I, 6.115, at 2330-1930 Berlin II, 7.150, at 2230-1930, and Ber lin III, 9.730, at 2230-1900. (Radi Sweden) AFN, 5.740, Beyreuth, note in Sweden 1200 with jazz music (Malmo DX-aren, Sweden)

*Gold Coast* — ZOY, 4.915, Accra shortly will increase power to 20 kw (Fox, N. Z., via Radio Australia)

*Greece—Radio Athens,* 11.718, note around 1240 in *English.* (Mast, N. Y others) *Central Forces Radio Station* 6.33, Athens, seems *nearer* 6.34 lately noted 1330 with call in Greek, the Greek music; also heard 0100 wit Greek songs. Larissa, 6.745, note 0115 with popular music. (Pearce England)

*Guadeloupe*—FG8HA, 9.430V, Basse Terre noted 1810 in French; close 2000 with "La Marseillaise." (Cox Dela.) Heard also erratically 0600 0630 closedown. (Stark, Texas, others

*Guam*—KUJ39, 9.490, noted *testin irregularly* around 0250. (Hooke Alberta)

*Guatemala*—TGWA noted openin 0730 on 9.760 (rather than old 15.1 outlet.) (Ferguson, N. C.) If no found on 9.760, try 15.17.

TGCQ, 9.702, noted around 2315 a weak level. (Cox, Dela., Stark, Texas TGNA lists frequencies of 720 kc 5.9525, 9.668, 11.850, 15.100 (*inactive* 17.870 (*inactive*). (Carroll, Me.)

*Haiti*—4VEH, Cap Haitien, note 0600-0900 on 9.69A, mostly *English* (Middleton, Ohio) 4VCP, Cap Haitien is now back on 6.993, modulation still poor. (Robbins, Ind.) *Radio Hai* noted recently parallel on 10.06A, 5.8 with *English* in progress at 2146 tun in; continued with U. S. popular mus until 2221 closedown. (Gay, Calif

*Holland*—Hilversum, 11.730, note with music 1700-1725, then sho newscast prior to 1730 closedow (Wade, Fla.)

*Honduras*—HRP1, San Pedro Sul has moved from 6.351 to 6.360 wher it mixes badly with Lisbon aroun 1800. (Robbins, Ind.)

*Hungary*—Budapest, 11.910, note in *English* 1800-1815. (Zerosh, Pa.)

*Iceland*—TFJ, 12.175, noted Sunday *only* in its 1115-1130 session in Ic landic; CWQRM, QSB. (Cox, Dela.)

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*Indo-China (Vietnam)* — *Rad France-Asie,* 6.116A, Saigon, not 0600 with news in French; on 11.9 with news 2030. Hanoi, 7.405, not 0630 with French program; is *Rad Hirondelle.* (Sanderson, Australi Saigon, 9.750A, noted opening 06 with "La Marseillaise;" heard on 1 935A at 1000-1115 at strong lev (Ishikawa, Japan) *Radio Laos* is hea at fair strength on 7.215 around 08 to closedown 0923 with "La Marse laise." "Voice of Vietnam," Saigo closes down around 0958-1001 and th announces use of 9.620, 7.288, 4.96 however, latter is heard on 4.960 (Japanese Short-Wave Club)

*Iraq—Radio Baghdad,* 11.725, not around 2308 in Arabic. (Bellingto N. Y., others)

*Israel*—Tel Aviv, 9.010A, noted wi "Voice of Zion" relay from Jerusale 1515-1600 closedown; asks for repor to Box 754, Jerusalem, Israel. (Ma N. Y.; Bjornert, Sweden, others)

*Jamaica—Radio Jamaica* verifi 3.360 with QSL card in two colors green and black. (Klein, Va., other

*Japan* — The Far East Netwo (AFRS), Tokyo, is scheduled 160 0645, JKL2, 9.605, JK16, 11.825; 050 1000, JKL, 4.860, JK13, 6.080. (Schei er, N. J.) JOA6, 15.135, JOA4, 11.70 noted opening in *English* to Weste North America 0000. (Hooker, A berta) JOA3, 9.675, heard 0600 wi news. (Sanderson, Australia)

*Luxembourg — Radio Luxembou* by now should have its *new* 50 k transmitter on the air on 6.090 0040-0930, 1045-1700 in French. (ISW London, others)

*Madagascar — Radio Tananariv* 9.515, noted with interval signal 222 signed on 2231 with "La Marsellaise

*Malaya*—Forces Broadcasting Ser ice, 5.010, Singapore, 7.5 kw., is sche uled 0645-0659 with tone; 0700-07 Swahili, Chinyanja; 0730-0800 Fijia 0800-0900 Gurka; *English* is to added shortly. (WRH, others)

*Mexico*—XEHH, 11.880, very stro 1745 with call in Spanish. (Norma N. C.)

*Monaco — Radio Monte Car* 7.349A, noted closing 1800 (some da earlier). (Cox, Dela.)

*Mozambique*—CR7BJ, 9.768A, Lou enco Marques, still noted with *Engli* from 2300 opening (from 0000 Sun (Littlefield, Mass., others) Heard 4.920AV at 1750 with popular mu and *English* announcements; end with Ted Lewis' "Goodnight Walt at 1800. (Cox, Dela.) Lourenco Ma ques, 4.872, noted with news in Port guese 1500, then music, closing a nouncements after chimes and ca played "A Portuguesa" and signed 1514. (Pearce, England) Heard sig ing on in Portuguese on 11.952A 0000, weak level in Ind. (Niblack)

*Nepal*—Still uses 7.10 with *Engli* 0845-0900. (Etersvep, Sweden)

*New Zealand*—Heard closing 06 on 9.540. (Middleton, Ohio)

*Nigeria—Radio Nigeria* is to crease power to 20 kw. shortly. (F N. Z., via Radio Australia)

orway—LLG, 9.61, Oslo, noted 2300-2400 (Sun. to 0020 . with "Norway This Week" in *English*) to West st, excellent level. (Riggs, Balbi, Calif.) Channels may be used during the year are LLQ, 21.730; LLP, 70; LLN, 17.825; LKW, 17.755; LLM, 15.175; LKV, 70; LLK, 11.850; LKQ, 11.735; LLH, 9.645; LLG, 9.610; ), 9.550; LKJ2, 9.540; LLR, 7.240; LLS, 7.210; LLI, 5; LKJ, 6.130; LKF, 1578 kc. (Hornstein, Mich.)

*akistan—Radio Pakistan* noted on 17.770 with news )-0210; in *English* 0515-0530 on 17.835. (Fernell, den) Noted with news 0330 and Western music 0400 17.710; news 0730 near 17.750 now. (Pearce, England) rd on 9.645A with *English* for Turkey 1430-1530 and Britain 1530-1615. (Pearce, England, Bellington, N. Y.) ed parallel on 11.885, 15.335 at 2035 tune-in with du music for Southeast Asia. (Bellington, N. Y.) Heard ning 0630 on 15.27, 17.770, much native music. (Ta- i, Japan)

*anama*—HOLA, 9.505, Colon, noted recently 2200-2400 edown. (Gay, Calif.) Heard in *English* 2130. (Horn- n, Mich.)

*eru*—OAX4H, 6.307, *Radio Mundial*, Lima, noted with in Spanish 2130. (McPhadden, Calif.)

*hilippines*—DZH3, 9.500, heard around 0700; uses com- rcials. (Stark, Texas) The Far East Broadcasting Co., nila, reports that the two *new* 10 kw. transmitters—for on 9.730, 11.855—are on order; one will be ready by fall, the other several months later; a *new* transmit- on 21.475 is expected to be in operation within a year; her power will be given all transmitters gradually. heiner, N. J.) DZH9, 11.855, heard best in Alberta 0-1200; noted closing 1203. (Hooker) DZ16, 17.804, ed 0130 with religious program in progress. (Sander- , Australia) DZH2, 9.640, Manila, noted 0600 at good el in Tokyo with news. (Ishikawa, Takemi)

*oland—Radio Warsaw*, 9.57, noted in *English* 1715- 0, strong signal. (Wade, Fla.)

*ortugal—Emissora Nacional*, Lisbon, is reported on ee *new* channels in the 25-m. band—11.797, 11.760,

11.835. (WRH) The 11.835 channel noted in Indiana at 1430. (Niblack) Signs on 1230. (Pearce, England)

*Reunion*—*Radio St. Denis* is heard in Sweden on 7.170 around 1625. (Radioklubben Universal, Sweden)

*Saudi-Arabia*—Djeddah now broadcasts on 725 kc., 3.960, 3.980, 5.975, 6.175, 7.245 at 2305-2335, 1045-1135, 1215-1335, and on 725 kc., 3.950, 5.975, 7.245, 11.850, 11.950 at 0605-0635. (WRH) (The 41-m. channel more recently has been heard around 7.300A instead of 7.245.) Noted by Pearce, England, opening with interval signal 1030 on 11.850A.

*South Africa*—Cape Town, 5.892A, noted 0110-0125 with morning produce market quotations in *English*. (Gay, Calif.)

*South Korea*—*Radio Korea* informs Scheiner, N. J., that the *new* 10 kw. short-wave and medium-wave transmitters to operate as *Radio Seoul* are still under construction; the 9.555 outlet in Seoul is still 300 watts, and there is another outlet there—HLKA, 3.8925, 1 kw.

*Spain*—Madrid, 9.363, noted in *English* for North America 1800-1840. (Middleton, Ohio, others) *Measured* 9.359 recently. (Roberts, Conn.)

*Switzerland*—HED5, 15.120, Berne, noted 1145 with *English*. (Mast, N. Y.)

*Tahiti*—In verifying, *Radio Tahiti*, Papeete, listed FO8AA, 6.980, 200 w.; FZP8, 6.135, 1 kw. Both use half-wave antennas. (Kary, Pa.)

*Thailand*—Bangkok, 6.240, heard with news by man 0515; 7.105 heard 0700 when identified in *English*.

*Trinidad*—*Radio Trinidad*, 6.085, noted 0515 when identified. (Stark, Texas) Heard closing 2202 with "God Save the Queen" on 3.275; good level, slight heterodyne. (Cox, Dela.)

## RCA'S PRINTED-CIRCUIT COMPONENTS

**THE tube department of Radio Corporation of America has announced the development of a series of printed-circuit components which is expected to stimulate the production of more compact and efficient radios, TV sets, and communications gear.**

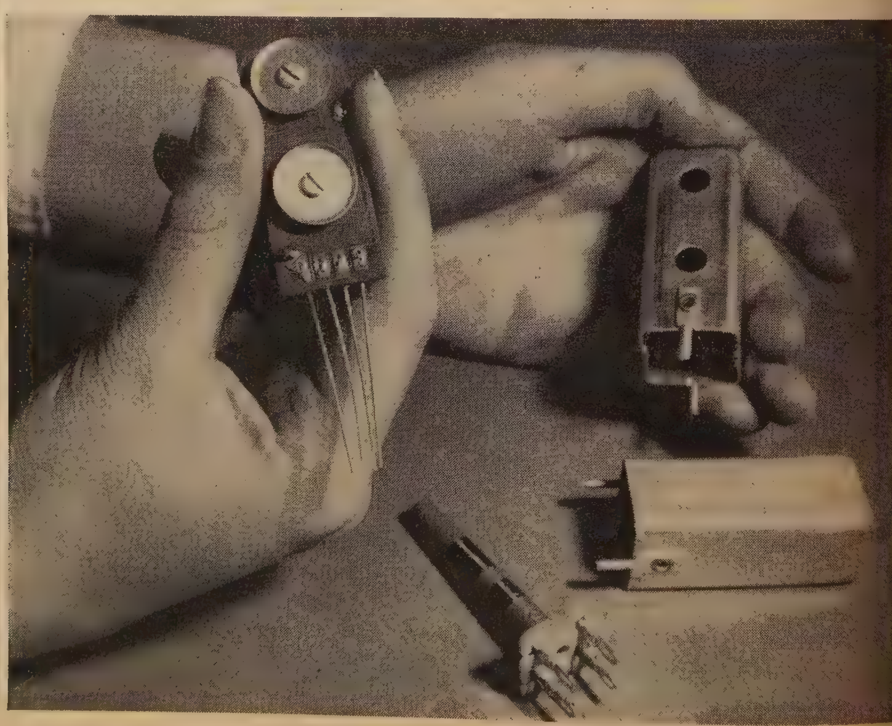
**These new components—six 40 mc. i.f. transformers, coils, and traps—are produced by a special photo-etching process which makes possible virtually limitless production of identical electronic circuits from a single photographic negative.**

**Conventional inductors depend upon coils of handwound or machinewound copper wire to provide the desired inductance values—the exact values are largely determined by the number of turns of wire, its spacing, and the diameter of the coil form. With the printed circuit method, both the copper wire and the wire-winding operations are eliminated. Inductances are provided by flat inductors having rectangular windings which are photographically printed on copper-clad plastic strips.**

**Although these RCA printed-circuit components are intended for applications in home television receivers, the same photo-etching process can be used to print circuits for components used in a wide range of radio and communications equipment.**

**The new components are i.f. types designed for television sets utilizing intercarrier sound systems and incorporating picture i.f. and sound i.f. carriers of 45.75 mc. and 41.25 mc., respectively. The presently-available components include a first video i.f. grid-circuit coil and trap; a first video i.f. plate-circuit coil; a second video i.f. grid-circuit coil; first and second video i.f. filter traps; second video i.f. transformer; and third video i.f. transformer.** —30—

RCA'S "Tandem" 40 mc. printed-circuit i.f. transformer used in home TV sets. A standard wirewound transformer is shown on table to permit a comparison of size.



# UBES & PARTS

[illegible]

| Tube | Price |
|---|---|
| 2A6, 2A7 | 89c |
| 2B3 | .89 |
| 2B7 | .89 |
| 2C34 | .60 |
| 2E5 | .89 |
| 2X2/879 | .74 |
| 3LP4 | 1.25 |
| 3Q4 | .69 |
| 3Q5GT | .89 |
| 3S4 | .69 |
| 3V4 | .95 |
| 5T4 | 1.40 |
| 5U4G | .59 |
| 5V4G | .87 |
| 5W4, 5W4GT | 59c |
| 5Y3GT | .45 |
| 5Y4G | .54 |
| 5X4G, 5Z3 | 81c |
| 6A3 | 1.68 |
| 6A7 | 1.21 |
| 6A8GT, 6AB4 | 69c |
| 6AB7 | 1.15 |
| 6AC5GT | .89 |
| 6AC7 | 1.45 |
| 6AG5 | 1.05 |
| 6AG7 | 1.49 |
| 6AH6 | 1.89 |
| 6AK5 | .89 |
| 6AK6 | 1.08 |
| 6AL5, 6AQ5 | 69c |
| 6AQ6 | .81 |
| 6AQ7 | 1.19 |
| 6AR5 | .79 |
| 6AT6 | .59 |
| 6AS5 | .90 |
| 6AU5GT | 1.29 |
| 6AU6 | .59 |
| 6AV5GT | .89 |
| 6AV6 | .59 |
| 6AX4 | .69 |
| 6AX5 | .79 |
| 6AX6 | .69 |
| 6AY5GT | .89 |
| 6B4G | 1.44 |
| 6B8GT | 1.15 |
| 6BA6 | .59 |
| 6BA7 | .89 |
| 6BC5 | .69 |
| 6BC7 | 1.05 |
| 6BD5GT | .89 |
| 6BE6 | .59 |
| 6BF5, 6BF6 | 69c |
| 6BG6, 6BG6G | 1.89 |
| 6BH6, 6BJ6 | 69c |
| 6BK7 | 1.19 |
| 6BL7 | .79 |
| 6BN6 | 1.19 |
| 6BQ6G | 1.19 |
| 6BQ6GT | 1.19 |
| 6BQ7, 6BZ7 | 1.29 |
| 6C4 | .59 |
| 6C5GT, 6C6, 6CB6 | 69c |
| 6C8 | 1.29 |
| 6CD6 | 2.49 |
| 6CD6G | 1.69 |
| 6D6/78 | 1.10 |
| 6D8G | 1.15 |
| 6E5 | .69 |
| 6F5GT, 6F6GT | 59c |
| 6F7 | 1.59 |
| 6F8G | 1.59 |
| 6G6G | .95 |
| 6H6GT | .89 |
| 6J5GT | .59 |
| 6J6 | .79 |
| 6J7G | .69 |
| 6J8G | 1.15 |
| 6K5GT | .69 |
| 6K6GT | .59 |
| 6K7GT | .69 |
| 6K8GT | 1.19 |
| 6L5G | .95 |
| 6L6G, 6L6GA | 95c |
| 6L7 | 1.19 |
| 6N6G | 1.40 |
| 6N7GT | 1.19 |
| 6P5GT | .69 |
| 6Q7GT | .59 |
| 6R7GT | .69 |
| 6S4 | .59 |
| 6S7GT | 1.15 |
| 6S8GT | 1.25 |
| 6SA7GT, 6SC7 | 69c |
| 6SD7GT | .99 |
| 6SF5 | .59 |
| 6SF5GT | .59 |
| 6SG7, 6SH7 | 69c |
| 6SH7GT | .69 |
| 6SJ7 | .79 |
| 6SJ7GT, 6SK7GT | 59c |
| 6SL7GT | .69 |
| 6SN7GT | .69 |
| 6SQ7, 6SQ7GT, 6SF7GT | 59c |
| 6SS7 | .99 |
| 6T7G | 1.15 |
| 6T8 | .89 |
| 6U5, 6U6GT, 6U7G | 69c |
| 6U8 | .89 |
| 6V3 | 1.29 |
| 6V6GT | .69 |
| 6W4GT | .59 |
| 6W6 | .69 |
| 6X4, 6X5GT | 59c |
| 6X8 | 1.29 |
| 6Y6G | .69 |
| 6Z4/84 | .72 |
| 7A4 | .95 |
| 7A5 | 1.19 |
| 7A6 | .89 |
| 7A7, 7A8 | 79c |
| 7B4 | .89 |
| 7B5 | .89 |
| 7B6 | .89 |
| 7B7, 7B8 | 89c |
| 7C4 | 1.30 |
| 7C5 | .89 |
| 7C6, 7C7, 7E5 | 79c |
| 7E6, 7E7 | 79c |
| 7F7 | .89 |
| 7F8 | 1.47 |
| 7G7 | 1.19 |
| 7H7 | 1.05 |
| 7J7, 7K7 | 1.19 |
| 7L7 | .79 |
| 7N7 | .69 |
| 7Q7 | .79 |
| 7R7 | 1.19 |
| 7S7 | 1.19 |
| 7V7 | .79 |
| 7W7 | 1.19 |
| 7X6 | 1.05 |
| 7X7, 7Y4 | 79c |
| 7Z4 | .89 |
| 12A7 | 1.59 |
| 12A8 | .69 |
| 12AH7 | 1.38 |
| 12AL5 | .54 |
| 12AT6 | .59 |
| 12AT7 | .89 |
| 12AU6 | .69 |
| 12AU7 | .79 |
| 12AV6 | .59 |
| 12AV7 | .89 |
| 12AW6 | 1.19 |
| 12AX4 | .69 |
| 12AX7 | .69 |
| 12AY7 | 1.95 |
| 12BA6 | .59 |
| 12BA7 | 1.19 |
| 12BE6, 12BF6 | 69c |
| 12BH7 | .89 |
| 12BY7 | .89 |
| 12BZ7 | 1.19 |
| 12F5GT | .65 |
| 12H6 | .89 |
| 12J5GT | .75 |
| 12K7GT | .69 |
| 12K8 | .89 |
| 12Q7GT | .89 |
| 12S8 | .89 |
| 12SA7GT | .69 |
| 12SC7 | 1.05 |
| 12SF5GT | .69 |
| 12SF7 | .99 |
| 12SG7 | .89 |
| 12SH7GT, 12SJ7GT, 12SK7GT, 12SL7GT | 69 |
| 12SN7GT | .99 |
| 12SQ7, 12SQ7GT, 12SR7GT | 69c |
| 12Z3 | .95 |
| 14A7 | 1.05 |
| 14AF7 | .93 |
| 14B6, 14B8 | 89c |
| 14C5 | 1.25 |
| 14C7 | 1.12 |
| 14F7 | 1.05 |
| 14F8 | 1.45 |
| 14H7 | 1.12 |
| 14Q7 | 1.05 |
| 14W7 | 1.19 |
| 14X7 | 1.19 |
| 19BG6, 19BG6G | 1.89 |
| 19T8 | .89 |
| 20 | 1.40 |
| 24A | .69 |
| 25AC5GT | 1.04 |
| 25BQ6, 25BQ6GT | 1.19 |
| 25L6GT | .59 |
| 25W4GT | .69 |
| 25Z5 | .69 |
| 25Z6GT | .69 |
| 32L7GT | 1.15 |
| 26, 27 | 59c |
| 35A5 | .99 |
| 35B5, 35C5, 35L6 | 69c |
| 35W4 | .59 |
| 35Y4, 35Z3 | 99c |
| 35Z4 | .75 |
| 35Z5 | .55 |
| 35/51 | .79 |
| 36 | 1.06 |
| 37 | .93 |
| 38, 39/44 | 88c |
| 41 | .72 |
| 42 | .69 |
| 43, 45 | 72c |
| 45Z5 | .69 |
| 46, 47 | 89c |
| 50A5 | 1.05 |
| 50B5, 50C5 | 69c |
| 50C6G | 1.39 |
| 50L6 | .69 |
| 50X6 | .69 |
| 50Y6 | .99 |
| 57, 58 | 79c |
| 70L7, 70L7GT | 1.49 |
| 71A | .87 |
| 75 | .79 |
| 77 | .69 |
| 78/6D6 | 1.10 |
| 80 | .69 |
| 83 | 1.45 |
| 84/6Z4 | .72 |
| 85 | .79 |
| VR90, VR105, VR150 | $1.19 |
| VT51, VT52 | 29c |
| 117L7 | 1.40 |
| 117N7 | 1.95 |
| 117P7 | 1.95 |
| 117Z3 | .59 |
| 117Z6 | 1.19 |
| 715B | 7.75 |
| 807 | 1.55 |
| 866A | 1.49 |
| 1299, 1619 | 29c |
| 2051 | 1.15 |

## SPECIAL

**For August only**

**10% DISCOUNT** on orders of 100 tubes or more, **5% DISCOUNT** on orders of 50 to 99 tubes.

## FREE

5 small screwdrivers with rotating handle and handy case with purchase of $20.00 or more.

## TELEVISION PICTURE TUBES

US YOUR
R AND WE
LL SHIP
M STOCK
EDIATELY

| Size | Price | Size | Price |
|---|---|---|---|
| 7 inch | $17.95 | 16 inch | $19.95 |
| 8 inch | 31.50 | 17 inch | 20.95 |
| 10 inch | 12.95 | 19 inch | 23.95 |
| 12 inch | 16.95 | 20 inch | 24.95 |
| 14 inch | 17.95 | 21 inch | 26.95 |
| 15 inch | 19.95 | 24 inch | 54.95 |
| | | 27 inch | 69.95 |

ONE FULL YEAR WARRANTY ON ALL TYPES

L TUBES $1.50 extra per tube
ostatic Tubes $1.50 extra per tube

## WE PAY FOR YOUR DUD

Your worn out picture tube is worth money if it is not broken.

| Size | We Pay | Size | We Pay | Size | We Pay |
|---|---|---|---|---|---|
| 7 | $1.00 | 14 | $3.00 | 19 | $4.00 |
| 8 | 1.00 | 15 | 4.00 | 20 | 4.00 |
| 10 | 2.00 | 16 | 3.00 | 21 | 5.00 |
| 12 | 3.00 | 17 | 3.00 | 24 | 9.50 |
| | | | | 27 | 10.00 |

These allowances apply when you purchase the same size picture tube and dud is shipped prepaid.

## AR
## E TV
## ENNA

*For UHF and VHF*

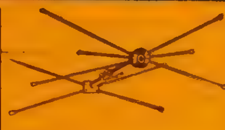
EIVES ALL CHANNELS
WE FINALLY DID IT

sed so many thousands of these ra- TV Antennas, that the cost has vn through the savings of mass n.

RE PASSING THESE SAVINGS ON TO YOU!

TV antenna with the new Electronic Dipole with the new Electronic Dipole is. Unbeatable for fringe area and low, low price we cannot mention irer's name. **$18.75**

INUM MAST heavy gauge $1\frac{1}{4}$" h interlocking end. Slip two sec- ther for a ten-footer. **$1.00**



## TV Antennas

10 Element conical . . . rugged through-out. Only . . . . . . . **$3.95**

Double bay array, with stacking bars . . $7.75

4 Bay array, with harness and stacking bars . . . . . . . . $14.95

6 Element Conical. Only . . . . . . . . $2.95

## JFD BOW TIE REFLECTOR

**UHF Antenna**

Bowtie Reflector
Ultra-high Gain

Completely assembled—ready to mount. For all UHF Channels — easy to stack for two or four-bay.

Single Bay . . . . . **$4.50**
Two Bay, complete . $8.45

## VTVM PRECISE

Vacuum Tube Volt-Meter, 1% accuracy ceramic precision resistors; Coax DC connector; FM zero alignment scale: burn-out proof circuit, rugged oversize $4\frac{1}{2}$" meter. Model 909, factory wired $44.98.
909K—Kit. Only . . . . . **$25.98**

## Model 300 Precise Oscilloscope

**Here Is the Buy**

7" tube size, Sweep magnifier, complete push-pull from input through output. Vertical sensitivity better than 10 millivolts. Bandpass — 0 — 3db., 0 to FIVE mc, complete with phasing control, blanking control, intensity mod. and self-measurement peak to peak feature, with DC amplifiers throughout as found only in scopes selling for over $950.00. Exclusive, easy maintenance feature.

In kit form ONLY . . . . **$94.95**

P. M. SPEAKERS

COAXIAL PM SPEAKERS [illegible] $12.[illegible]

COAXIAL SPEAKER [illegible] $19.95

[illegible] NATIONAL BRAND [illegible]

SPECIAL PRICE

## TV CONVERSION KITS

Consisting of rectangular tube, 70 DEGREE YOKE, Beautiful Mask and FLYBACK TRANSFORMER.

| | |
|---|---|
| 21" TV Conversion Kit, as above, complete | $31.95 |
| 20" TV Conversion Kit, as above, complete | 28.95 |
| 17" TV Conversion Kit, as above, complete | 23.95 |
| 24" TV Conversion Kit, as above, complete | 69.95 |
| 27" Conversion Kit, as above, complete | 89.95 |

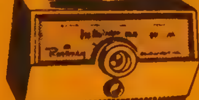
### MISCELLANEOUS BUYS

I.F. TRANSFORMER—456 Kc [illegible]
PILOT LIGHTS, Type No. 47 [illegible]
VOLUME CONTROLS with SWITCH, 2" shaft, 1 meg. [illegible]
SINGLE ION TRAPS [illegible]
DOUBLE ION TRAPS [illegible]
OUTPUT TRANSFORMER [illegible]
CHIMNEY MOUNT for TV [illegible]
6-foot LINE CORD UL [illegible]
TV INTERLOCK CORDS [illegible]

## TUBE KITS

BEST BRANDS AT BEST PRICES

| | |
|---|---|
| 3V4, 1T4, 1R5, 1S5 . . . | $2.19 |
| 3Q4, 1T4, 1R5, 1S5. List Value $8.00. Tube Kit only. | $1.98 |
| 3S4, 1T4, 1S5, 1R5. List Value $7.80. 4-Tube Kit . . . | $1.98 |
| 1U4, 3S4, 1S5, 1R5. List Value $7.80. All Four Tubes for . . . | $1.98 |
| 117Z3, 1U5, 3S4, 1R5, 1T4. AC-DC Portable Kit. All for | $2.49 |
| 12AT6, 12BA6, 12BE6, 35W4, 50B5. 5 Tubes for . . | $2.59 |
| 35Z5GT, 12SQ7GT, 12SK7G, 5 Tubes for . . . | $3.22 |



## REGENCY UHF CONVERTER

UNIVERSAL-CONVERTERS ALL SETS—the only converter recommended for the 5,000,000 split sound and video TV sets now in use as well as all intercarrier TV sets.

NET . . . . . . . . . . . . **$37.46**

## RESISTOR KITS

Insulated ½, 1 and 2-watt assortment of most used values, I.R.C. Ohmite, Stackpole, Speer, etc., 100 for . . . . . . **$2.95**

## 300 OHM TWIN LEAD

| | |
|---|---|
| 55 Mil, 100 ft. | $ 1.59 |
| 1,000 ft. | 13.95 |
| 20 Ga, 80 Mil, 100 ft. | 1.89 |
| 1,000 ft. | 16.95 |
| UHF TUBULAR 300 OHM LINE 1,000 ft. | $34.50 |
| 100 ft. | $4.95 |

## Selenium Rectifiers

| | |
|---|---|
| 75 mil | 79c |
| 100 mil | 89c |
| 150 | $1.10 |
| 200 | $1.48 |
| 250 | $1.59 |
| 300 | $1.79 |
| 350 | $1.98 |
| 450 | $2.45 |

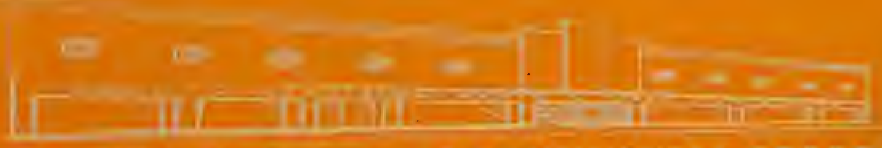
## Teleron TV Wave Trap

For VHF Channels 2 through 13. Clears VHF picture, stops interference at once, 30 seconds to attach.
ea. net **$1.75**

## "SERVICE SHORT-CUTS"

One highly successful executive once said that he spends an hour each day with his feet up on the desk doing nothing but thinking. While you don't have to go quite to this extreme, you can profitably spend an hour a day reading one of the many well-written books available that not only tell you how television sets operate but also what goes wrong with them and how they can be fixed. Why sweat out the same mistakes others have made when a little time spent reading can save you lots of time on difficult service jobs? We have prepared a list of recommended books both for the beginner and the advanced technician. If you drop us a card, we will be happy to send you a copy free and without obligation.

**ERMS:** 20% DEPOSIT with order, balance C.O.D. ALL shipments F.O.B. Chicago. ORDERS LESS THAN $5.00—$1.00 SERVICE CHARGE. CABLE ADDRESS: CONTULAB. These prices supersede all previously advertised prices, subject to change without notice.



MIER RADIO-TV SUPPLY, division of CONTINENTAL CORPORATION





*Turkey*—*Radio Ankara* noted in *English* 1600-1645 n on 15.160 to Western Europe, Britain. (Golden, Ma others) Still has powerful signal in *English* to No America daily 1815-1700 over TAT, 9.515. (Wade, Fl Oestreich, Wash. State, others)

*Uruguay*—CXA19, 11.835, Montevideo, noted 1715 good level with music. (Cox, Dela.) CXA10, 11.909, M tevideo, is good level daily around 2100. (Norman, Ferg son, N. C.)

*USI (Indonesia)*—Djakarta, 9.710, strong with ne 0900, 0945. (Hooker, Alberta) Heard opening 1400 af chimes on 11.785 to Europe-New Zealand; announces 9. parallel in this beam which closes 1500. (Pearce, Englan

*Western Samoa*—By this time, Apia should have *tes* on 6.040 and (later) 3.241; probably will settle down one of these channels and may follow the m.w. sched of 1700-1900 Sun.-Wed.; 2200-2300 Sun.-Wed.; 0230-0 Mon., Wed., Sat., 0230-0530 Fri.; 0330-0430 Sun. (Schein N. J.)

*Zanzibar*—The Information Officer, Box 344, Zanzibar, forms Scheiner, N. J., there is one station operating that country—"Sauti ya Unguja," 4.795, 250 w., 1000-1 in Swahili *only*.

* * *

### Press Time Flashes

*Radio Somali*, 7.125, Brt. Somaliland, is on the air 08 0930; all-Somali language; transmitter is *RCA* type 4331 with nominal output of 1 kw.; uses half-wave dip antenna. (Radioklubben Universal, Sweden)

Forces Broadcasting Service, Tripoli, has been no around 1845 on 4.785; closes 1600A with "God Save Queen." (Pearce, England)

More recently, *Radio Africa*, Tangier, has been us 7.193 again instead of 7.126; noted 1030 with popu music. (Pearce, England)

Damascus, Syria, has been noted recently on 11.7 around 1900-2100 closedown (parallel 11.913A), evide to Latin America. (Niblack, Ind., Bellington, N. Y.)

HS8JS, Thai Army Radio, Thailand (Siam) is heard fair strength 0630-0700 on 4.870; programs in T (Cushen, N. Z.) ALF, 9.915A, Juneau, of the Alaskan C munications System, noted *testing* 2230 at excellent le (Niblack, Ind.)

Ishikawa and Takemi, Japan, say *Radio Free Japa* Red-Chinese operated, heard on 11.896 and 10.180 at 0 0830 in Japanese; location is North Korea; strong leve Tokyo.

*Radio Pakistan*, 11.884A, lately has had news 20 (Ferguson, N. C.)

The *new* s.w. VOA relay station at Salonika, Greec scheduled on 6.040 at 1215-1645 to Europe; 7.270 at 0 1645, 1730-0130 to Europe; 11.735 at 0900-1230 to US Middle East. URDXC says is 35 kw.

Cairo, Egypt, noted on *measured* 11.966 around 1 2046 closedown; seems parallel 6.085 (Ferguson, N. Niblack, Ind.; Bellington, N. Y.)

At press time, Balbi, Calif., reported Peking, 6. weak 0400 with news; 7.50 fair, 10.26 weak, 11.67A f 6.200 good level 0500 with Home Service. USSR hear China from 0230 on 15.11, 11.72, 11.75, 9.725, 9.66, 9. 6.11, 6.055; signing off 0900.

Catch, England, flashed he had noted Lisbon, 9.742, o ing to Brazil, Cape Verde Islands, Portuguese Guine 1600, excellent level; ZPA5, 11.950, Encarnacion, P guay, fair level 1645; ZYP23, 5.045, Petropolis, Brazil, 1725; a station, probably the *Yugoslav Emigrant Sta* noted opening with march 1720 on 6.283, and clandes *Radio Espana de Independiente*, noted on 10.280 ar 1730. And Niblack, Ind., noted CE1173, Santiago, C at 1940-2030 on 11.945AV one day, next on 11.965A.

* * *

### Acknowledgement

Thanks for FB reports! *ISW DEPARTMENT* moni certificates for 1953-54 are now available—*gratis* to reporters to the Department. Send reports and requ for monitor's certificates to Kenneth R. Boord, Stewartstown Road, Morgantown, West Virginia, U ..................................................K.

# W "PAY-AS-YOU-WATCH" SYSTEM

*office Television's new closed-circuit transmitter for makes possible retransmissions on Channels 2 through 13.*

ever-mounting cost of television gram sponsorship is causing and more companies to cast a ive eye at the various "TV-for- systems which have been devel- in the past few years.

ough not as yet sanctioned by CC, several companies are pro- g with the development of ment to handle this type of mission.

ong the new items on the mar- *Boxoffice Television's* "Picture- r", a unique closed-circuit trans- r for television pictures and .

unit accepts video and audio any source—a receiver, camera , coaxial line, generator, etc. and mits them into any type of mission line on any v.h.f. chan- 2 through 13. The transmitter ency is crystal-controlled, with sound and video carriers auto- ally maintained 4.5 mc. apart est results with intercarrier re- rs. AM pictures and FM sound receivable on all standard TV

system as it operates now, in nction with master antenna sys- is inexpensive and easily in- d and operated.

e audio and video are piped by a common carrier (such as telephone company lines) to each master antenna system which is part of the network. These normal signals are then fed into the "Picturecaster" which scrambles the picture so that while it can be tuned in in the normal way it cannot be viewed.

The special decoder with which the receiving set is equipped consists of an inexpensive tube circuit, which is installed in one of the receiver's existing tube sockets, and a box with a keyhole.

To view an unscrambled picture, the user inserts the key in the keyhole and the picture comes in clear. Keys can be rented for various periods of time, the rental depending on the program material to be received. The key rental is the fee for watching the program. Removing the key scrambles the picture again so that a single key cannot be used to operate several receivers.

The equipment is undergoing extensive testing at the present time in anticipation of an FCC OK on "Pay-As-You-Watch" programming. —30—

**Max Genodman, president of United Elco a contracting firm specializing in hotel master antenna system installation), inserts the decoding key in the rear of television set equipped to receive Boxoffice Television's closed-circuit TV.**

**unting, treasurer of Bell Television, master antenna TV system operating is shown with a demonstration set- corporating the new "Picturecaster" he TV set with which it is employed.**

# MANUFACTURERS' LITERATURE

**Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO & TELEVISION NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.**

### INDICATOR LIGHTS

*Dialight Corporation,* 58 Stewart Ave., Brooklyn 37, N. Y. is currently offering a copy of its new brochure, L-153.

This four-page publication describes and illustrates the company's line of subminiature indicator lights for various applications. Units described fall into five general categories: for plastic plate edge lighting, indicator lights, dimmer types, light shield, and indicator lights with "press-to-test" feature.

When writing for a copy of this brochure, address your requests to Mr. E. Greene of the company.

### REPLACEMENT GUIDE

*Standard Transformer Corporation* of Chicago has prepared a "Tape-Wire Recorder Replacement Guide" which lists sixty-three models by twenty-two companies manufacturing tape and wire recorders.

The Guide has been published to meet the need for authoritative information on power transformer, filter choke, and audio output transformer replacements, according to the company.

Manufacturer and model number, manufacturer's part number and *Stancor* part numbers are listed for all models included in the Guide.

Distributors and service technicians may secure a copy of this guide by writing the company at 3580 Elston Avenue, Chicago 18, Ill.

### CONVERTER AND BOOSTERS

*Electro-Voice, Inc.* of Buchanan, Michigan has issued a new bulletin covering its u.h.f. converter and v.h.f. booster line.

Features, specifications, and other details on these products are covered in Bulletin No. 182. Information on the company's 3300 u.h.f. converter, "Tune-O-Matic" and "Tenna-Top" boosters is given in detail.

### U.H.F. BOOKLET

How its signal generators can be adapted for u.h.f. applications is the subject of a new booklet, "How to Use the *Simpson* 478-480 for U.H.F. Alignment", currently available from *Simpson Electric Company,* 5200 W. Kinzie Street, Chicago 44, Ill.

The booklet describes how the company's v.h.f. test equipment can be adapted for use in u.h.f. service work. By following the instructions given in the publication the technician can obtain signals of the type, accuracy, and strength necessary to identify the nature of troubles in u.h.f. circuits.

Copies of this booklet are avail without charge from the company

### TRIAD TRANSFORMERS

The new catalogue just release *Triad Transformer Corporation* 4055 Redwood Avenue, Venice, ( fornia lists more than 500 item interest to technicians.

The publication features an panded line of TV components industrial transformers including oids, pulse transformers, transi transformers, and additional mi tures. The catalogue also contai geophysical section.

Copies of Catalogue TR-53 ma obtained by writing the com direct.

### DISTRIBUTOR CATALOGUE

Dealers and technicians, in addi to the company's distributors, are rently receiving copies of the 1953 *Mallory* distributor Catal No. 553, according to the compar

The new publication lists and scribes more than 2200 items, mo replacement components which handled through the company's di butor system. For the first time catalogue also includes list prices the items covered.

A copy of this new catalogue be obtained by writing to *P. R. lory & Co. Inc.,* 3029 E. Washin St., Indianapolis 6, Ind.

### ANTENNAS AND ACCESSORIES

A 36-page catalogue of telev antennas and accessories has bee sued by *Radio Merchandise Sales,* of 2016 Bronxdale Ave., New 60, N. Y.

The new publication covers items necessary for receiver inst tion from the rooftop to the set i The catalogue contains a ger alphabetical index which provid logical breakdown of accessory gories which helps speed the loc of the desired parts.

As a further aid to the techn for whom the catalogue is inter *RMS* has included a technical section. Copies of this publication available from the company's dist tors or from the company itself.

### "GLASSEAL" CATALOGUE

A new 20-page catalogue cov its line of "Glasseal" condensers been issued by *Pyramid Electric pany,* 1445 Hudson Boulevard, N Bergen, N. J.

Designated as Catalogue PG-3 new publication contains complet

ng data, performance curves, ction styles, sizes, capacitance, ltage listings for the subminia- nits.

es of this two-color catalogue vailable without charge upon ead request direct to the manu- er.

### TUBE CHARACTERISTICS

Receiving Tube and TV Picture Divisions of *Sylvania Electric ts Inc.*, 1100 Main Street, Buf- Y. has released new versions haracteristic booklets. The two ts, revised and brought up-to- are available without charge an be obtained through the ny's distributors or the com- Advertising Distribution De- ent at the above address.

"Television Picture Tube and l Purpose Cathode Ray Tube" teristic chart has been revised lude the latest modifications, hanges, etc. Over 30 tube types been added, which brings the types listed in the booklet to 50. There are 56 different bas- diagrams accompanying these ypes.

revised "Radio and Television ing Tubes" booklet includes, in on to previously listed types, the television receiver and sub- ure tubes. Over 750 different ing tube types are listed in hart along with their basing ms.

### NEEDLE REPLACEMENTS

*Recoton Corporation*, 147 West Street, New York, N. Y. has is- a 1953-54 edition of its "Simpli- eference Guide to Replacement es."

igned to assist dealers in select- e correct replacement part, the is thoroughly cross-indexed for eference.

ies are available without charge the company on request.

### DEALER AID

ew thermometer designed to at- the attention of customers of and television dealers is now ble from parts distributors of *ue Products Co.*, 51 Marshall t, North Adams, Mass.

elve inches in diameter, the eas- sible face is finished in charac- ic *Sprague* orange and blue. her-sealed in an aluminum case tdoor as well as indoor use, this ometer is available to radio and sion service technicians through *prague* jobbers or may be ob- d postpaid by sending a $4.00 or money order to the company. for Thermometer D-114.

### U.H.F. ACCESSORIES

*sley Electronics, Inc.* of 8622 harles Rock Road, St. Louis 14, uri is currently offering a copy new catalogue which lists and ibes the company's line of tele- installation accessories.

talogue 53-54 offers several of

the company's new products wh[...] have been designed for the particu[...] requirements of u.h.f. as well as v.[...] television installations.

Copies of this publication are c[...] rently available from radio and te[...] vision parts jobbers or from [...] company direct.

### VIBRATOR GUIDE

A completely revised "1953 Vibra[...] Guide" is now available from *P. Mallory & Co. Inc.* of Indianapolis, Ind.

The new guide is a complete vib[...] tor handbook for the auto radio te[...] nician. Containing nine sections [...] valuable information, it includes r[...] erence sections prepared according [...] the *Mallory* replacement numb[...] original equipment number, vibra[...] type and application, and manuf[...] turer's replacement number.

Sections are included which sh[...] the company's vibrator specificati[...] and base diagrams, installation no[...] and circuit diagrams, buffer conden[...] reference circuits, auto battery grou[...] chart, and auto radio service notes.

The "Vibrator Guide" contains [...] pages and sells for 15 cents.

### STANDBY POWER

*D. W. Onan & Sons Inc.,* Minnea[...] lis, Minnesota has issued a two-co[...] folder which describes and illustra[...] its line of standby power units [...] communications systems.

The folder shows examples of p[...] table and mobile electric plants on [...] job providing primary electric pow[...] for mobile TV studios, radio rem[...] broadcasting units, television main[...] nance trucks, and mobile CD cente[...]

A copy of Communications Fold[...] Form A-307, is available on request.

### PRE-RECORDED TAPE

The *A-V Tape Libraries, Inc.* of [...] Fifth Avenue, New York, N. Y. [...] published a new catalogue of pre-[...] corded tapes for home, office, a[...] classroom use.

The handy, pocket-size publicat[...] lists many new semiclassical comp[...] tions, "pops", vocal varieties, as w[...] as a lecture series on English lite[...] ture and Bible readings.

A copy of this new catalogue [...] available on request from the co[...] pany.

### COMPONENT PARTS

A new two-color catalogue cover[...] TV and radio components is n[...] available from *Heppner Manufact[...] ing Company,* Round Lake, Illinois.

Illustrations and detailed descr[...] tions are given on slip-on ion tra[...] snap-on ion traps, centering devic[...] correcting magnets, PM speakers, [...] speakers, ferrite rod antennas, flyba[...] transformers, and PM "Focomags".

### RCA TRANSISTORS

The Commercial Engineering [...] partment of the *RCA Tube Depa[...] ment,* Harrison, N. J. has issued [...] 8-page booklet describing its n[...] transistors.

ided in the booklet is informa- n the company's Type 2N32 ontact transistor for use in r switching applications where erating frequency for voltage- ut-off of .9 mc., an operating ncy for current-gain cut-off of , and a high current amplifica- factor are important design erations.

Type 2N33 point-contact unit e in oscillator service at fre- es up to 50 mc. is also described. types 2N34 and 2N35 junction stors of the *p-n-p* and *n-p-n* type tively are covered in some

n of the four types has a base three small pins in line and to provide mechanical index- r socket insertion. —30—

## HOW MUCH IS YOUR LABOR WORTH?

NFORMATIVE little booklet is available to all radio and televi- ervice technicians from the How- . Sams Co., 2201 E. 46th St., apolis, Ind. The publication of- n intelligent approach to the set- p of labor costs for service estab- nts of varied requirements. tten by Donald B. Shaw, vi ent and treasurer of the compan, ooklet is a "must" for all service operators. It contains informa- n the simplest possible ways of ting labor and assuring compen- for time and business expenses operation of a one-man shop. It explains "productive labor" (the performed on a repair job for you can charge a customer at a rate). These examples are also on a one-man shop. Shaw demonstrates how these general principles may be applied an owner adds personnel. The et concludes with a discussion of llocation of overhead expenses to ofitable departments of the busi- —30—

eteoric rise of the Heath Company of Harbor, Michigan continues unabated firm announces the opening of a new on which more than doubles its facili- r the design and production of all of test equipment in kit form. The building houses enlarged laboratory es, assembly lines, and office space e expanded staff of clerical work- ecessitated by increased business.

# RECTIFIERS AGAIN

By THOMAS R. HUGHES

THIS is a further commentary on my article, "Unrecognized Hazards in Electronics," which was published in the April issue of this magazine. Since this article appeared, I have received some objections from the manufacturers of rectifiers who feel that it may have placed the use of selenium rectifiers in a bad light.

I want to assure you that I had no such intention, in fact—if anything—I meant to accomplish the opposite. Being a safety engineer and, at the same time, an experimenter in sound equipment and electronics, I was somewhat concerned over a previous article on the subject, in another publication, that included misinformation and exaggerations.

My article was aimed at electronics designers, maintenance men in factories and plants, and radio or television technicians in repair and service shops. It was not expected to apply to users of electronic equipment in the office or home, nor to workers in selenium rectifier manufacturing plants (where suitable precautions are observed).

Selenium rectifiers have provided the means for valuable progress in many fields where direct current is required. Though they are used extensively in the electronics and aircraft industries in California, we apparently have no record of serious injury as a result.

My article was not intended to cause alarm in the mind of any reader but it was my wish to call to the attention of those who deal with large rectifiers that the existence of toxic fumes is possible.

While there is little in past experience to base opinions on, I left the implication that one could dismiss the normal use of small rectifiers (in radios, television, etc.) as a source of serious hazard. However, since the uses of electronic circuits and their supply from rectifiers are invading more fields every day and we have no means of anticipating their applications or misuse, we cannot let possible hazards go unrecognized.

Thus, I went to some pains to outline the precautions that one could observe if he felt any concern over his application of a rectifier. I used the word "should" in some places and was careful not to imply that any of the precautions recommended were absolutely required.

One more point that I feel should be cleared up is what I meant by a "burn-out." I used the word "arc-over" as electricians use it—to indicate that damage was caused by electricity passing over the surface of a dielectric or insulator rather than through an internal short circuit. I find that my use of the term was misinterpreted as referring to the momentary flashes frequently occurring during the first energizing of the cells in manufacture.

By a "burn-out," I was referring to the breakdown of a group of cells and the burning, by prolonged arcing or conduction of current, to chemical compounds differing from those required for normal operation. In other words, its destruction as a rectifier.

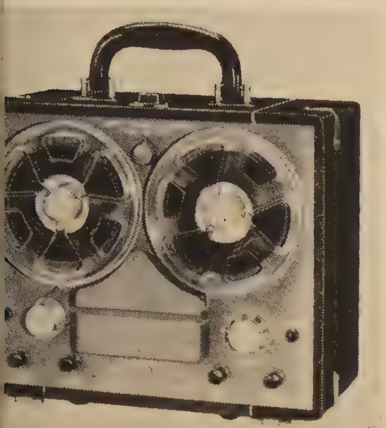
I hope this will be of value in removing any discredit my article may have brought to selenium rectifiers. In their present state of perfection they merit our high regard as simple, foolproof servants.
—30—

# WHAT'S New in Radio

For additional information on any of the items described herein, readers are asked to write direct to the manufacturer. By mentioning RADIO & TELEVISION NEWS, the page and the issue number, delay will be avoided.

### PORTABLE RECORDER

e Magnematic Division of *Ampli-Corp. of America,* 398 Broadway, York 13, N. Y. is now offering a



117 volt, a.c. portable tape re-er which weighs 19 pounds and ns a frequency response of 50 to 0 cps at 7½ inches-per-second.

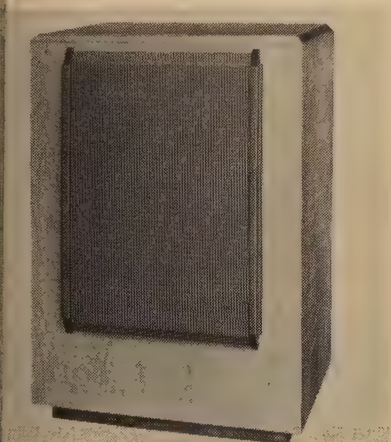
mpletely operated by push-button ol, the new unit features a sole-operated, clutch-controlled cap-drive to start and stop tape el within 1/20th of a second.

e "Magnematic" is designed for eme simplicity of operation; it is edly constructed to withstand the rs of portability, and provide max-n stability and dependability of ormance.

r complete technical specifica-and prices write the company t.

### BASS REFLEX ENCLOSURE

*am Instruments Corporation,* 350 h Avenue, New York 1, New York added two new wall and corner bass reflex loudspeaker enclo-s to its line of "Tannoy" housings.



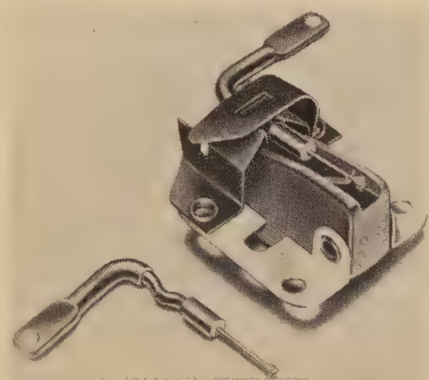
hile designed to be used with the pany's dual-concentric speakers, new enclosures can be used with other makes of 12- and 15-inch loudspeakers. They are constructed of ¾" lumber with all joints close battened, screwed and glued. Interiors are completely insulated to absorb internal standing waves and sound reflections.

The wall-type enclosure is designated as the "Westminster," the corner-type has been named the "Parliament." The "Westminster" is 39½" high, 28" wide, and 19¾" deep. The "Parliament" is 42¾" high, 30" wide, and 20½" deep. Both styles are available on a custom basis.

### TURNOVER CARTRIDGE

*Sonotone Corporation* of Elmsford, New York is now offering a new phonograph pickup design, the "Titone Turnover."

Using a high-compliance, high-sensitivity ceramic element and a unique turnover method, the new cartridge provides some interesting characteristics. Requiring no equalizers or pre-amplifiers, the cartridge has an out-



put of one volt and is unaffected by moisture or temperature.

The jewel needle tips (either diamonds or sapphires) are mounted back-to-back on a single shank, the entire assembly rotating for needle change. When replacement is required, the complete needle assembly, including the lever handle, is removable as a unit.

### NEW UTAH BAFFLES

*Utah Radio Products Co., Inc.* of Huntington, Indiana has added a series of wall baffles to its line of products.

The new baffles have been tradenamed "Utone" and are designed and engineered to give a maximum of clean, life-like tone. The baffles are built without a single nail, all joints being mortised and secured with waterproof glue. They are self-mounting, needing no metal brackets for installation.

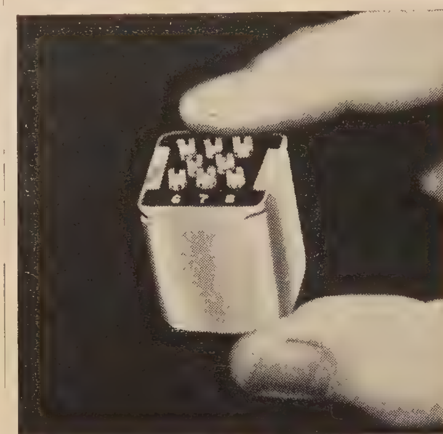
They are available in four sizes for 6, 8, 10, and 12 inch speakers and

come in three finishes—red or brown mahogany finish and futuristic blonde finish. All sizes are also available in natural, unfinished wood.

### STANCOR "TINYTRANS"

*Standard Transformer Corporation,* 3580 Elston Ave., Chicago 18, Ill. is now marketing a new line of miniature high-fidelity audio transformers, known as *"Stancor* Tinytrans."

The miniature units are made with nickel steel laminations, with a fre-



quency response of ± 1 db, 30-15,000 cps, maximum level 0 db. They are sealed and potted in ⅞" square, anodized aluminum cases with phenolic terminal boards. Total height, including terminals, is only 1¼". The case has two 2-56 threaded inserts, 1¹⁄₁₆" centers, for easy chassis mounting. It weighs only 1.3 ounces.

A bulletin on these units is available on request.

### REGULATED SUPPLY

*Kepco Laboratories,* 131-38 Sanford Ave., Flushing 55, N. Y. has introduced the Model #400 voltage regulated power supply which features one regulated "B" supply, one regulated "C" supply, and one unregulated filament supply.

The "B" supply is continuously variable from 0-400 volts and delivers from 0-150 ma. Ripple voltage is less than 5 millivolts. The "C" supply is continuously variable from 0-150 volts and delivers from 0-5 ma. The filament supply delivers 6.3 volts at 10 amperes and is unregulated, center-tapped, and ungrounded.

The power supply is designed for relay rack mounting or bench use. The cabinet is 7" high, 19" wide, and 11" deep. The weight is 40 pounds.

### SUPPORT CHANNELS

*The Lowell Manufacturing Company* of 3030 Laclede Station Road, St. Louis, Mo. has announced the availability of a line of steel support channels which simplify the installation of sound system speakers in suspended ceilings.

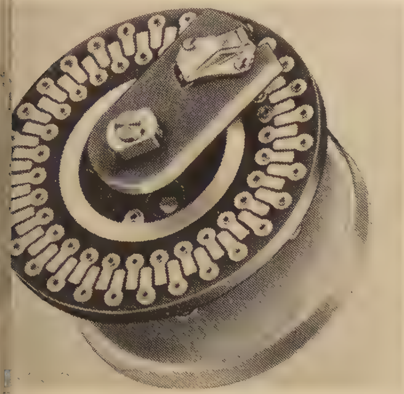
These channels are available for 24" and 48" spans and are easily installed in any standard type of suspended ceiling construction. They can be used in either new or existing ceilings.

ecifications and information on steel support channels are avail- from the company on request.

### PRINTED-CIRCUIT SWITCH

e *Daven Company,* 191 Central ue, Newark, N. J. now has avail- a new printed circuit rotary ch Type PCF-1 with 60 position, ing-type action.

elets are provided for solder con- ons at every position. The Type



-2, having non-shorting positions, so available. The switch segments silver-alloy bonded to the phenolic act panel. The rotor arm is the pany's "knee-action" type rotor h provides uniform contact pres- and very low contact resistance ughout switch life.

ntact resistance is approximately to .004 ohm and does not vary e than .0003 ohm over the life of unit. The diameter is 3" and the h is 2$\frac{1}{16}$".

dditional information is available h Dept. PCS of the company.

### GERMANIUM DIODES

line of nineteen point-contact ger- nium diodes has been announced the transistor division of *National on Radio Corp.* of Hatboro, Pa.

he encasing cartridge is composed a plastic material impervious to sture and having good electrical racteristics and mechanical sta- y at high temperatures. The stiff minal pins permit clipping of the into spring terminals either for or circuit application and the ible leads permit soldering or er suitable connection means.

n engineering bulletin, No. 1001, es electrical specifications on the eteen new units. It is available on uest.

### GENERATOR ADAPTER

he Accessory Division of *Philco poration,* Allegheny & "A" St., ladelphia, Pa. is in production on Model G8000 v.h.f.-to-u.h.f. signal erator adapter.

he company's u.h.f. tuner is the rt of the new adapter. It permits asurements to be made at u.h.f. le controls, markers, and attenua- s are operated with the usual con- ience at the common v.h.f. fre- ncies.

s the output from any v.h.f. signal erator at 60 mc. is fed into the

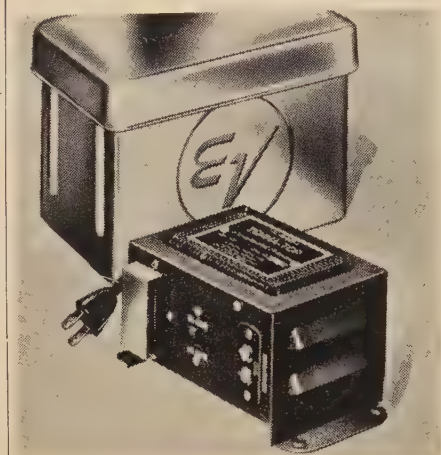
adapter, the v.h.f. sweep or marker signal beats against the u.h.f. oscillator of the unit, producing u.h.f. signals having the same characteristics as the v.h.f. input signal.

The company will supply full details on this and other units in its test equipment line on request.

### TV BOOSTER

*Electro-Voice, Inc.* of Buchanan, Michigan is now offering a new, improved Model 3012-A, 3-tube automatic, all-channel television booster, for v.h.f. applications.

A new low-noise, broadband circuit



multiplies the signal at the antenna. Three tubes in balanced stages, including a power multiplier stage, are used to provide adequate gain for producing clear, sharp signals.

The booster unit is housed in a weather-resistant case which mounts on the antenna mast. The junction box plugs in between the receiver and an a.c. outlet. Input and output are to 300-ohm balanced line.

Bulletin No. 182, available from the company, describes the Model 3012-A in detail.

### LEAD-IN WALL PLATE

A new television lead-in wall plate socket that requires no wall opening or outlet box has been announced by *Mosley Electronics, Inc.* of 8622 St. Charles Rock Road, St. Louis 14, Mo.

The new socket mounts flush on the wall or baseboard and may be installed in seconds with a screwdriver. Designated as the F-2, the new unit was designed to meet the need for plug-in convenience. The socket is available in brown or ivory molded polystyrene and is supplied with mounting wood screws. It is also available packaged with one mating constant-impedance solderless plug.

Write the company direct for additional information.

### TUBE SALVAGE

*Kahle Engineering Co.* of 1307 Seventh Ave., North Bergen, N. J. has developed and is manufacturing a combination neck cutting and neck splicing machine that will salvage larger size cathode-ray picture tubes.

Rejected tubes in 24", 27", 30", 33", and larger sizes can be easily and rapidly returned to the assembly line as all operations are performed with one handling of the bulb.

The Model 2185 is a single head machine that takes all standard sizes and shapes of tubes. The neck cutting operation is performed by the hot-chill method, producing a clean, square cut. The cut-off mechanism is adjustable up and down. Neck tubing can also be cut.

The company will supply complete specifications and performance data on this unit to manufacturers writing the firm direct.

### TUBULAR TWIN-LEAD

A new tubular twin-lead for u.h.f., designed so that attenuation is negligible under all weather conditions, has been announced by *Plastoid Corporation* of 42-61 24th St., Long Island City 1, New York.

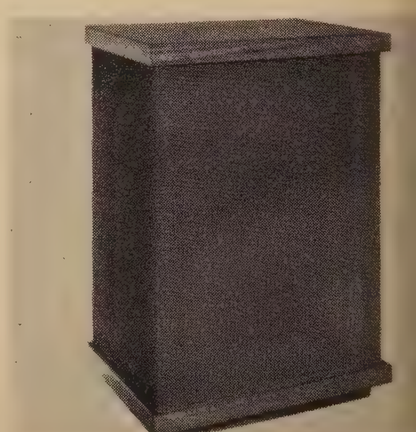
Known as "Synkote Ultratube", the new transmission line has the leads spaced several millimeters within the tube, equidistant from the outer insulation. Thus the magnetic field between them is unaffected by any moisture or salt which may condense on the outer covering and the signal strength is maintained at a maximum all the way down to the receiver.

The new twin-lead can be used not only for u.h.f. but for peak transmission of v.h.f. signals in stormy weather, in fringe areas, and in seacoast areas where moisture and salt spray are factors.

### NON-CORNER HORN

A non-corner horn, tradenamed "The Purest", has been recently introduced by *Gately Development Laboratory,* Barrington, N. J.

The unit is a new type baffle employing a horn load on the back side of the speaker it encloses for improved low-frequency response, at the same time permitting direct radiation of high frequencies. The enclosure is designed for use along any wall and does not rely on the walls of the room to act as an extension of the horn. The unit gains adequate horn mouth



area by exhausting on three sides of the enclosure. Total fold of the horn is 180 degrees.

"The Purest" is available for 12 c

...h speaker systems. Standard ...s are dark mahogany, blonde, ...atural mahogany. It is also ...ble unfinished for those who de... do their own finishing. Over-all ...sions are 38″ high, 28″ wide, and ...deep. Technical literature is ...ble on request.

### "CUSTOM SOUND ENSEMBLE"

... *General Electric Company* has ...nced additions to its line of ... products which will be mar... under the name "Custom Sound ...ble".

... ensemble consists of a pream... control unit, a 10-watt ampli-

...and a dual coaxial speaker. A ...speed record changer equipped ... the company's variable reluc... cartridge is used with the ...n for demonstration purposes.

... units are so designed as to ... them adaptable to either cus...nstallation or as separate furni...pieces.

...l details on all of the units com...g the new line are available ... *G-E* dealers and distributors.

### 24-INCH TUBE

...*S-Hytron* of Salem, Massachu...s has recently added the Type ...4 to its line of television picture ...

...s 24-inch rectangular, 90 degree, ...ass, magnetically-focused picture ...provides an effective screen area ...er 370 square inches. It features ...luminized screen for increased ...tness, spherical filter-glass face ... single ion-trap gun design, and ...xternal conductive coating which ...s as a filter condenser.

...formance and engineering data ...e Type 24TP4 are available on ...st.

### HI-FI COMPONENT LINE

...e Engineering Products Depart... of *Radio Corporation of America* ...tly introduced its initial line of ...hed high-fidelity sound reproduc...system components.

...hough the new components will ...arketed individually to preserve ...flexibility and freedom of choice ...nded by most hi-fi enthusiasts, ...acteristics are carefully matched ...nsure maximum performance in ...system.

...ilt around the *"Olson* speaker", ...ine will include a deluxe three... automatic record changer, two ...FM tuners (one a deluxe instru-

ment with built-in preamp), four different high-fidelity amplifiers, three hi-fi speakers (8", 12", and 15") and separate speaker and equipment enclosures.

The line will be marketed through *RCA* electronic parts distributors and is expected to be available in September.

### SX-88 RECEIVER

*The Hallicrafters Company* of Chicago has recently introduced its SX-88 communications receiver which has been designed to replace the company's SX-28.

The new receiver is said to offer an exceptionally high degree of usable

selectivity, incorporate a new audio system which provides for standard broadcast reception with near high-fidelity quality, and features a reduction of selective fading in short-wave reception.

The unit uses 17 tubes, plus voltage and current regulator and a rectifier. Six tuning bands cover a range from 535 kc. to 33 mc. Over-all dimensions are 20" long, 10⅜" high, and 18¼" deep. It weighs 65 pounds.

The SX-88 is currently available at dealers.

### TRANSMISSION LINES

*Fenton Company,* 15 Moore St., New York 4, New York is featuring two new products, "Fentube-Airspaced" and "Twistube" which are designed to give better reception on u.h.f. and v.h.f. by reducing interference pickup.

The "Fentube-Airspaced" uses one common covering tube which surrounds and is fused to the spiral cords to the extent of from about 180 to 270 degrees of a circuit. There is practically no dielectric between the conductors.

"Twistube," besides being air-spaced, incorporates the added feature of being transposed to equalize the average proximity, and thus the capacity, of both conductors in relation to the mast and other grounded objects. The twin conductors are uniformly transposed which drastically reduces interference pickup. —30—

### TRANSISTOR PRICE CUT

*Raytheon Mfg. Co.* of Newton, Mass., has announced a new low user price of $4.50 for its CK722 junction-type transistors.

The price reduction, according to a company spokesman, was made possible by the greatly increased production of these units.

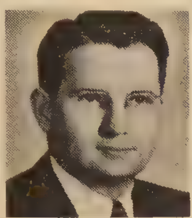
## Within the Industry

(*Continued from page* 26)

its net worth in 1953 was $41,-
00 and its original six employees
increased to 10,000. Sales in-
ed from $63,000 in 1928 to $168,-
00 in 1952. The company op-
s plants in Chicago, Quincy,
nix, New York, Philadelphia, De-
and Toronto for an aggregate of
000 square feet of space.

* * *

**H R. SHIELDS** has been named to newly-created post of product manager of sion picture for *Sylvania ric Products*



joined the mercial engi- ng department he company's tube division nporium in 1948 as a senior engi- He joined the merchandising rtment in 1950, assuming super- of test equipment products. In ollowing year he was given an ional responsibility as supervisor tributor sales engineering, which ded a nationwide program of spe- rojects and meetings. In October he was appointed merchandising visor, television picture tubes, headquarters at Seneca Falls,

* * *

**HYTRON** has purchased a 42,000 e foot plant in Lowell, Mass. h will be used to manufacture istors and germanium diodes. ent plans call for the employment to 1000 people, but the company aken an option on adjoining prop- for future expansion . . . **SPIRLING UCTS CO., INC.** has built a new at Hicksville, Long Island which enable the firm to increase pro- on of its line of indoor and out- TV antennas. The new address is ). Box 411, Hicksville . . . **TRI- T MANUFACTURING AND DEVELOP- CO.** has moved into a new and rn plant at 401 Grand St. in klyn, N. Y. The company special- in the machining of plastics for electronic, electrical, aircraft, etc. stries . . . The Statistical Depart- of **RADIO-TELEVISION MANUFAC- RS ASSOCIATION** has moved to and enlarged quarters in Room Bond Building, 1404 New York ue, N. W., Washington 5, D. C. **ERIE RESISTOR CORPORATION** of Pa. is building a new plant for the ufacture of electronic and plastic ucts at Holly Springs, Mississippi, iles south of Memphis, Tenn. . . . **RISON RADIO CORPORATION** has oved its Jamaica Branch from 172- 144-24 Hillside Avenue in Jamaica rovide larger warehouse and sales ities for its Queens and Long nd customers. The new location ures convenient drive-in shipping

and receiving platforms and 5000 square feet of service area on a single floor . . . **GATES RADIO COMPANY** of Quincy, Illinois has opened a new and larger office in New York City at 51 E. 42nd Street, across the street from the Airlines Terminal Building . . . **CBS-COLUMBIA INC.** has moved its administrative offices from its Brooklyn plant to its new Long Island City plant at 3400 47th Avenue . . . A second plant has been opened by **HEPPNER MANUFACTURING CO.,** Round Lake, Ill. manufacturer of television components. The new plant at Mendota, Ill. will be devoted exclusively to the manufacture of ferrite rod antennas and flyback transformers . . . **GENERAL ELECTRIC COMPANY** has opened a new tube warehouse at 3800 N. Milwaukee Ave. in Chicago. The structure provides almost 100,000 square feet of floor space and will serve as headquarters for the company's central regional sales organization for electronic tubes . . . **PHILCO CORPORATION OF CANADA** is erecting a modern, 80,000 square foot plant at Don's Mills, a Toronto suburb, which will be devoted to the manufacture of television receivers, radios, and other electronic equipment. The plant is expected to be ready for occupancy early in 1954. The company is currently operating in rented quarters in Toronto . . . **RAYTHEON MANUFACTURING COMPANY** has started a $1,750,000 modernization program at the former Lowell (Mass.) Ordnance plant. The plant was occupied last November by the company and the modernization program is being carried out while the plant is in production . . . **SYLVANIA ELECTRIC PRODUCTS INC.** has announced plans for a new 416,000 square foot television set manufacturing plant to be built in Batavia, N. Y. The plant is expected to be completed by Feb. 1, 1954.

* * *

**RAYMOND C. COSGROVE** has been elected to the post of chairman of the board of the *National Company,* succeeding William A. Ready who retired recently.

Mr. Cosgrove was formerly executive vice - president of *Avco Manufacturing Corp.* and president of Radio Television Manufacturers Association.

Mr. Ready is the oldest official of an electronic manufacturing firm still active in the ARRL. He has been an official of the company for 38 years and until March of this year served as president and chairman of the board.

* * *

**E. F. JOHNSON COMPANY** of Waseca, Minn. has purchased the inventory, tools, dies, and rights to manufacture the *Signal* line of telegraph instruments and keys. The line was formerly manufactured by **SIGNAL ELECTRIC MANUFACTURING COMPANY** of Menominee, Mich. . . . A new organization for the development and manufa[cture] of electronic equipment has bee[n] formed under the name of **AMPL[I]TRONIX INC.** at 280 Ninth Ave., Ne[w] York 1, N. Y. Products include mult[i-] waveform generators, projectio[n] scopes, electronic timers, and oscill[o]scope calibrators.

* * *

**THE WESTERN ELECTRONIC SHOW** ninth annual meet will open Augu[st] 19th at the Civic Auditorium in Sa[n] Francisco for a three-day run.

Almost 80 per-cent of the electron[ic] manufacturers of this country will o[c]cupy 327 booths to display produc[ts] used in broadcasting, communication[s,] telemetry, servicing and installatio[n] accessories, etc.

The trade show is closed to the ge[n]eral public and no home receivers [or] other strictly consumer items will [be] displayed.

Four technical sessions daily will [be] sponsored by the (7th Region) Ins[ti]tute of Radio Engineers. —[30]

## ATLANTA HAMFEST

**THE Atlanta Radio Club, Inc., will ho[ld] its annual Hamfest on August 30 at Robinson's Tropical Gardens near A[t]lanta, Georgia. The menu will inclu[de] fried chicken and free drinks, and t[he] program features games and activiti[es] for YL's and XYL's as well as conte[sts] and a transmitter hunt for the men.**

**Admission will be $3.00 for adul[ts] $1.75 for children. Reservations a[nd] further information can be had from R. Warren, W4RVH, 490 Angier Av[e.] N.E. (Apt. #3), Atlanta, Georgia. —[30]**

## MARS CD PLANS

**BY JOINT agreement the Departme[nt] of Army and the Department of A[ir] Force have issued the policy indicat[ed] below to military commanders in t[he] interest of providing guidance relat[ed] to civil defense planning.**

**"Within the scope and mission of t[he] MARS program as approved and pu[b]lished, the use of MARS facilities as [a] military communications asset in su[p]port of Civil Defense will be govern[ed] by these policies. Within the curr[ent] availability of personnel and equipme[nt] MARS may:**

**a. Make available communicati[ons] services between the military forces [in] support of civil defense and the c[ivil] defense agencies.**

**b. Make available communicati[ons] services for civil defense forces on [a] temporary or emergency basis wh[en] such services are not otherwise availab[le].**

**c. Make available radio terminal [fa]cilities at designated military insta[lla]tions for civil defense tie-in as requir[ed].**

**d. Make these services available [on] military frequencies assigned to est[ab]lished MARS networks."**

**The military requirement for MA[RS] and the availability of personnel, equ[ip]ment, and frequencies during periods [of] national emergency will govern the [ex]tent to which MARS services can [be] made available to Civil Defense ag[en]cies.**

**A survey will be conducted by MA[RS] in order to determine those civil[ian] members who will be qualified and w[ill]ing to participate in this commun[ica]tions support mission.** —[30]

## Home Security Radio

(Continued from page 62)

ately 10 microvolts-per-meter. econd series of trials was next to compare the sensitivity of the ers when situated in unfavor- eception locations. In this test 00 watt and less stations in a ile radius were recorded with- ouping according to power. The r of these stations which could ged by each of the three sets etermined and the per-cent re- was calculated. This pattern ollowed for three locations: an the ground site, a householder's and a "bomb shelter."

A-2 receiver, when set up in the was provided with 20 feet of ntal antenna one and one-half elow grade. The "bomb shelter" culvert 33 feet long, 18 feet and 7½ feet high, open at each nd overlaid by reinforced con- and a secondary roadbed. The horizontal antenna of the ency receiver was positioned center of the culvert and per- ular to its long axis. The three were geographically less than lf mile apart.

comparative sensitivity of two receivers in the three locations wn in Fig. 4B. The security re- is superior to the commercial ube portable at two sites but at the third, the "bomb shelter," they appear as equal. Lack of apparent superiority of the A-2 receiver in the shelter site may be explained by the fact that there was no signal of intermediate strength. The culvert attenuated weak surface signals to a nondetectable level while strong original signals penetrated the culvert sufficiently to be heard by both receivers.

Immediately following an enemy attack on a large metropolitan area, each surviving household would require vital information and instruction to forestall panic. Instruction could be broadcast, lacking telephone and metropolitan broadcast service, by utilizing a sensitive battery-operated receiver tuned to a transmitter located in a neighboring community. A home security receiver designed for this purpose and operating from a single No. 6 dry cell is described. The sensitivity of this receiver assayed at ground level, in a cellar, and in a simulated bomb shelter was superior to a commercial four-tube portable vacation radio but less than that of a commercial communications receiver.

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[2] Schmidberg, W.: "Treatment of panic in casualty area and clearing station," Life and Letters Today, Autumn 1939.

[3] Passow, E. B.: "Preselection in Inexpensive Broadcast Receivers," Electronics, September 1941.


—30—

## Electronics for Yachtsmen

(Continued from page 67)

The radio direction finder has begun to find acceptance among small boat owners in recent years. Basically, it is a sensitive radio receiver with a very directional loop antenna which can be rotated on a compass-calibrated base. When beamed on known signal sources, generally RDF (radio direction finder) stations or charted broadcast stations, the boat's position can be established. Once this point is known, it is plotted on the chart and the new compass bearing determined. From there on it is a simple matter to hit the destination "on the nose."

While these are the only really important items needed aboard small craft, there are other pieces of electronic gear that contribute to the safety of the boat and the peace of mind of the captain. Moderate cost radio depth finders (fathometers) are now available and are being enthusiastically accepted by yachtsmen who cruise outside of charted areas. The instrument gives an indication of the depth of the water based on half the time it takes the signal to be transmitted from the boat to the bottom and return, with some allowance being made for mud penetration. In addition to preventing accidental grounding of the boat on hidden reefs, the fathometer is being used extensively to locate schools of fish whose massed bodies reflect the sound waves in the same way that the sea bottom does. Like the direction finder, the depth finder can be used to advantage in fogs and other closed-down conditions. By comparing depth readings from the graph with depth readings on the navigation charts, a fairly educated "guess" as to location can be made.

Since many small boats do not have the battery capacity to operate all this equipment for any extended period of time, extra generators (run from the motors), extra batteries (if possible), and shoreline battery chargers and eliminators are essential. Batteries can be recharged either at the boat's destination or in its home port. Power lines are run to the boat when in port and the charging handled there.

In addition to the safety radio equipment aboard a boat, many owners are adding such purely pleasure gear as television receivers and small portable radios. Television lends itself particularly well to use in close quarters and provides ready-made entertainment when in strange ports. Because of the load, it isn't practical to run the television receiver from the boat's battery supply but in port where it can be operated from power lines it is a real addition to the basic equipment. The requisite a.c. is available at most commercial and yacht club piers.

The boat, "Miss Eico", shown on

month's cover is a 31-foot cabin
er which carries a full comple-
of electronic devices including
fferson Travis (Emerson)* 35-watt
otelephone. The unit covers four
s and a spare (two ship-to-ship; one
t Guard emergency; one marine—
*System*—telephone channel; and
spare). Calls may be made to any
hone by contacting the nearest
ne telephone operator. The cost
e call is the regular toll charge
an additional fee of $1.00. There
o monthly carrying or minimum
ge.

e boat also carries a *Bludworth
ne* radio direction finder, the
el DF1029A. This unit covers
e bands (one of which is the
dcast band) and has a range of
miles. It will operate on 6, 12, or
olts d.c.

e depth finder aboard the craft is
*ndix* recording model which is ca-
e of measuring depths from 0 to 100
oms (0 to 600 feet). It has a sin-
range and may be operated from
er 12 or 32 volt power sources.

her units include a *Surrette* bat-
charger (12 volts) and an *Eico*
el 1040 battery charger for 6 and
olts. This latter unit can be used
rovide the requisite 6 volts needed
perate small appliances aboard the
, the major pieces of electronic
being operated by either 12 volts
or 117 volts a.c. The a.c. is avail-
in ports and is fed into the boat
means of an outlet in the rear
pit. The boat carries dual wiring
h permits the lights, battery
ger, small appliances, the televi-
set, etc., to be run from the a.c.
er lines when the boat is docked.
Model 1040 battery charger also
vides power for the regular 6 volt
when in port.

meter to measure transmitter
out is an extremely useful item as
ells at a glance whether or not
signal is getting out. A "Chargi-
r" which indicates the charge on
of the boat's four batteries by a
of the switch completes the oper-
g gear aboard. In addition, a tele-
on receiver and a radio receiver
provided for the entertainment of
sts.

hile all of the equipment aboard
tandard, it may be a little more
orate than that desired by the
rage boat owner. Radiotelephone
s (*RCA, Pearce-Simpson, Hudson-
erican, Fisher,* etc.) range in price
n around $230 to $760. They may
obtained with as few as two chan-
or as many as six and provide
erage from a minimum of 20 to
miles. Installation charges are
a. Crystals for the various bands
about $15.00 a pair. Antennas for
with such equipment range in
e from a modest $25.00 for a
e-built unit comprising a bamboo
, some wire, and a swivel socket
a commercial unit in the $80 price
s. Incidentally, the swivel socket
"must" for sailing under station-
bridges or up tree-lined inlets, etc.

Direction finders fall in the $200 to $400 price class and range from units which operate from four self-contained batteries and cover 100 miles to units which operate from the boat's 6, 12, or 32 volt power supply, cover three bands, and are effective for distances up to 125-200 miles. One recently announced unit which has been especially designed for small boats and lean pocketbooks is being offered at a price in the neighborhood of $85.00. This simple device consists of a receiver capable of tuning the marine, aircraft, and local broadcast bands, an earphone, and an antenna.

Depth finders, as produced by *Bendix* and *Raytheon,* are priced from $350 to around $1000 depending on the features incorporated. One modestly priced unit features a rotating disc and indicator light. It reads from 1 foot to 160 feet. Another model has two ranges, one for 1-100 fathoms and the other for 1-200 fathoms, while a still more elaborate version keeps a permanent record of the bottom over which the boat is traveling.

Needless to say, there are any number of other devices which can be included should the size of the boat and the wishes of the owner so dictate. *Radiomarine Corp.* is now offering a compact 3.2 cm radar unit which has been designed for small craft while a photoelectric-type automatic pilot which operates on the gyro principle is being made available to yachtsmen who do a lot of open-water cruising over long distances.

While many of the items described herein may appear to be unduly elaborate for a small craft, in reality none of the items could be considered "luxuries" since, in conditions of fog or bad weather, every single piece of electronic gear becomes a "life-line" which may be responsible for saving the crew and/or the boat itself—a point well worth considering.

No matter how few or how many pieces of electronic equipment you have aboard, take the word of an experienced "skipper" when he advises that the more protective devices available the more comfortable and trouble-free the cruise. Being ready for any emergency is one of the marks of an "old hand". Electronic gear helps you to anticipate such emergencies and handle them smoothly should they be unavoidable. —30—

## DELTA CONVENTION

**AMATEURS of the Delta District will hold a convention in New Orleans on September 5-6 at the Jung Hotel on Canal Street.**

**Sponsored by the Greater New Orleans Amateur Radio Club and by the Westside Radio Club of New Orleans, a full program of sightseeing, convention sessions, and displays has been planned for amateurs and their wives.**

**Contact A. L. Powell, W5MXQ, at 224 Hollywood, New Orleans 20, La., for further information.** —30—

## HAM CLUB ACTIVITIES

**THE Baltimore Amateur Radio Club, Inc. has scheduled its Sixth Annual Hamfest-Picnic for Sunday, August 9th at Triton Beach, Mayo, Maryland. Tickets are $1.00 per person (children half price) and include the use of the bathing facilities, bath-house, locker, use of picnic tables, and pavilion.**

**An interesting program has been planned and there will be awards for the best mobile installations. The festivities are scheduled to start at 10 a.m. W3PSG will be on hand to guide visiting mobiles.**

**For further information write Chairman Ernie Dobos, W3JCL, 2208 North Fulton Avenue, Baltimore 17, Maryland.**

* * *

**THE Seventh Annual Ham Outing of the Buckeye Shortwave Radio Association will be held August 30th at Happy Days Camp, Virginia Kendall Park, located just north of Akron, Ohio on Route 303, .8 mile west of Route 8.**

**Registration is set for 2 p.m. with a fee of $2.00 per family. Prizes for young and old have been provided. For further details contact R. J. Nuss, W8KDW.** —30—

## Spot Radio News

(Continued from page 18)

. . . new communication tech- and facilities . . ." is back in om once again with another eanic telecasting proposal. Un- sideration now is a "Narcom" h Atlantic Relay Communica- system, which calls for relays his country to London, by way ada, Greenland, Iceland, and

e earlier plan which revolved Near East operations about relay stations were envisioned. estimated that the network ent alone would cost up to $15 while annual network opera- ould involve a budget well over ter of a million dollars. Cost rating each of the relay sta- would be about $25,000, and mming could run up a figure of llion. Then there would be the al problem and cost of servic- d maintenance not only the itters and associated gear, but ion receivers, also included in oject. According to Senator who sponsored the measure, 3 to $4 million would be re- at the beginning and only 5000 receivers would suffice. s present form, the global plan be included within a "Voice of a" program and probably sup- t or supplant audio transmis- o certain countries.

ATIONAL TV, which reached a tic stage a short time ago, as adline for reserved channels with little reaction from com- l interests, recently received support from the headman Senate Interstate and For- Commerce Committee, Senator s W. Tobey.

ewing FCC's position on school ion, the Senator said: "I shall a watchful eye on each and one of these 242 channels for ion, and upon the slightest ce that the FCC is about to n and to delete one of them or ute a substantially less valu- hannel for one of them, I shall r a full-scale investigation."

ers supported the Senator. Con- han Heller pointed out that few ware of the . . . "importance of ction taken by the FCC or of reat significance of the gift it resented to the American peo- He felt that reservations of the tional channels should continue nitely, regardless of pressure the commercial world, or the ent included within the freeze- der.

roval of a move to delay can- of the special channels, was voiced during the nomination ngs of Commissioner John C. er. Senator John Bricker noted ducational television offers great

possibilities and educators should be given every chance to put up their own stations. He declared that while it would not be wise to have educational institutions take over TV, we would be . . . "passing up one of the great opportunities in the educational field, if we don't reserve channels for them."

When the reservation deadline passed, technically the Commission was in a position to change a channel from reserve for education to commercial, or even the reverse; change commercial to a reserved state. In addition, the government could add a new channel to any city, whether it presently has channels allocated to it or not, and could also remove a channel from any city and assign it to another. It also became possible to substitute or exchange channels among cities, whether they were on the very-high or ultra-high bands. A change in the minimum mileage separation required between a channel in one city and a co-channel or adjacent channel in another city now also can be entertained.

In some quarters, educational interests have been very active. In New Jersey, for instance, a commission report to the governor proposed the erection of a six-station network and allotment of $190,000 to continue research in programming, already under way at New Brunswick, and $425,350 for construction of station and allied facilities.

Suggested was the building of a station with a studio on the campus of Rutgers University, using a 5-kilowatt transmitter and antenna at Washington Rock State Park, Watchung. Other stations, it was reported, would be built in the vicinity of Montclair, and another with a studio in the Camden area with the transmitter and antenna in the Mount Holly vicinity. Still others would be erected in the vicinities of Freehold, Hammonton, and Andover. Local boards of education would be responsible for providing receiving facilities, the r[...] port continued.

Among those who served on t[...] report commission were Drs. Elm[...] W. Engstrom of *RCA* and Allen [...] DuMont. Engstrom served as cha[...] man.

**MICROWAVES,** often described [...] the eventual home of many, ma[...] services, was recently the subject [...] one of the most searching analys[...] ever offered by a spokesman of t[...] Commission; Edwin L. White, ch[...] of the Safety and Special Radio Se[...] ices Bureau.

Speaking before the Petroleum [...] dustry Electrical Association in Hou[...] ton, Texas, he said that the one o[...] standing characteristic of microwa[...] systems is the ease with which t[...] radiations of the transmitters a[...] angle of acceptance of receivers c[...] be restricted. In view of this fe[...] ture, the same frequency can be a[...] is being used in the same geographi[...] area by two independent point-to-po[...] systems, without noticeable interf[...] ence, it was pointed out. If t[...] engineering can be carried to the ul[...] mate, White said it might well [...] that, as a matter of policy, the Co[...] mission could assign identical frequ[...] cies to a number of systems in t[...] same area without harmful mut[...] interference resulting.

Exploring some of the benefits a[...] some of the possible drawbacks [...] such a procedure, the Commissio[...] expert said that if such a procedu[...] is practicable, the number of potent[...] channels in any one area could beco[...] so large that some of the means [...] frequency economy applied to in[...] vidual systems might become unnec[...] sary. For example, he pointed out[...] may not make too great a differe[...] if passive reflectors are used, and f[...] quency requirements for any point-[...] point system doubled thereby. T[...] bandwidth required for multiplex[...] might not be of great importance[...] was revealed. Under such an id[...]

# NEW TV STATIONS ON THE AIR

(As of July 25, 1953)

The following new stations brings the lists published in previous issues up to date.

| STATE, CITY | STATION | CHANNEL | FREQUENCY RANGE (IN MC.) | VIDEO WAVELENGTH (IN FT.) | VIDEO POWER (IN KW.) |
|---|---|---|---|---|---|
| Kansas | | | | | |
| Hutchinson | KTVH | 12 | 204-210 | 4.79 | 115 |
| Minnesota | | | | | |
| Rochester | KROC-TV | 10 | 192-198 | 5.08 | 105 |
| Missouri | | | | | |
| Kansas City | KCTY | 25 | 536-542 | 1.83 | 93 |
| Nebraska | | | | | |
| Lincoln | KFOR-TV | 10 | 192-198 | 5.08 | 59 |
| Ohio | | | | | |
| Akron | WAKR-TV | 49 | 680-686 | 1.44 | 145 |
| Ashtabula | WICA-TV | 15 | 476-482 | 2.06 | 20 |
| Texas | | | | | |
| San Angelo | KTXL-TV | 8 | 180-186 | 5.43 | 11 |
| Texarkana | KCMC-TV | 6 | 82-88 | 11.8 | 18.5 |
| Wisconsin | | | | | |
| Madison | WMTV | 33 | 584-590 | 1.68 | 16.5 |
| Milwaukee | WCAN-TV | 25 | 536-542 | 1.83 | 105 |

*From Station CP application.

The frequency of the video carrier = 1.25 + channel lower freq. limit.

Total number of television stations now on the air: 207 (49 of which are u.h.f.[...]

, the report added, the Commis- could allow each system to be as applicant might desire, both as hoice of equipment and as to ulti- capacity, and there would be no to inquire into the plans of the icants for future growth. Thus, Commission might assign a chan- of from 8 to 10-mc. width to each owave system, leaving it to the see to make his choice of modula- system, and use as much of the nnel as his needs dictate, provided, ourse, that the techniques used did result in occupancy of frequencies side the channel or produce radia- outside of the geographic area vided for the system.

nfortunately, White said, for some e were a few problems that could urb the bright prospects. For the ile and broadcast systems, the uencies above 800 or 900 mc. are too attractive. And, information al- ndicates that above approximately or 10,000 mc., atmospheric ab- ption is also serious. Because of e conditions, the report noted, it well be that at some future time may find that because of require- nts for mobile uses we cannot af- to use the frequencies below 800 for point-to-point communications. his should happen, White declared, nt-to-point systems designed to rate in the lower portion of the ctrum would be forced to vacate move up to those frequencies suit- for point-to-point, but unsuitable mobile work. Notwithstanding the rference situation above 10,000 , extremely high powers can be d to overcome this atmospheric blem, as radar operation has lved. Under these circumstances, petroleum specialists were told, fixed frequencies between 800 and 000 mc. might be reserved for inter- point-to-point systems and the d frequencies above 10,000 mc. ld be reserved for intracity net- ks and to connect the suburban terminals of intercity networks with central urban terminals.

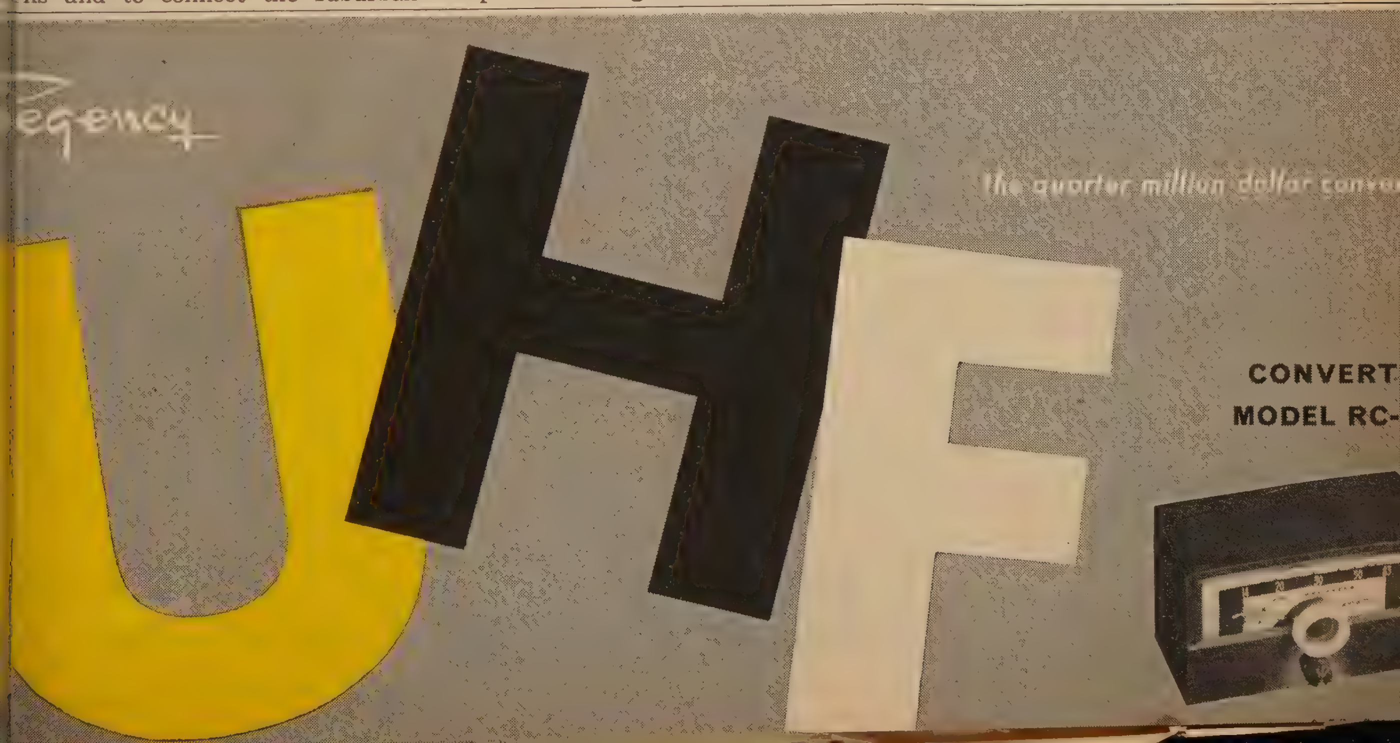
Noting that the number of micro-wave systems is growing, White disclosed that there are approximately 60 fixed microwave communication systems which are over 50 miles in length, in addition to possibly 75 to 80 other systems which consist of one or two hops only.

FACED WITH mounting hearing problems, examiners have found it impossible to maintain the early post-freeze pace and grants have begun to trickle instead of pour as they did in the first few months.

As the table on page 16 reveals, the number of approvals for station construction has dropped substantially; over 50 per-cent in this instance as can be readily seen.

It is believed that this situation will be alleviated soon by Congress by means of an appropriation to permit the hiring of more examiner teams. It is expected that about $300,000 will be appropriated for the cause, and at least seven more teams of examiners will be retained. Since one team can handle about 15 applications yearly, the present ten and additional seven would be able to process 255 applications a year. Senator Ed Johnson has been arguing for even more money so that more lawyers and assistants can be hired to expedite further the processing of applications. He warned his colleagues that actually Congress would be continuing the freeze if they did not approve funds for more examiner teams. He would like to see a total of 40 teams in action at the Commission's offices. Such a force, he felt, would enable more stations to begin telecasting and set in motion a chain reaction which very quickly would create billions of dollars in business. Everyone is grateful to the driving Senator for his earthy plea for these urgently needed dollars. It is to be hoped that Congress concurs....L.W.





## 1953 Emerson TV Sets
(*Continued from page* 55)

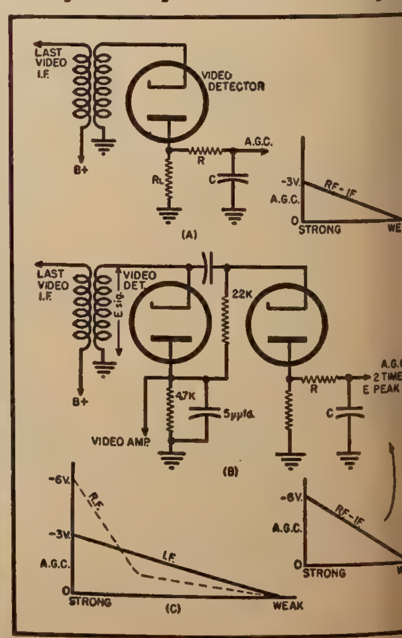
of horizontal and vertical sync. Th was remedied by attenuating the si nal, or by simply removing the fir r.f. amplifier, usually a 6J6 or a 6CI tube. On the other hand, when a s was installed in a fringe or wea signal area, the contrast, or sign strength, could be improved by shor ing out the a.g.c. line completel permitting the receiver to run "wi open," always in the maximum ga condition.

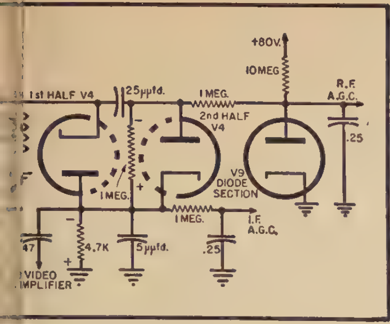
Upon close examination, it will noticed that the "trick" of obtaini good reception in all signal areas d pends upon the amount of amplific tion the receiver obtains from the r amplifier. In strong-signal areas t r.f. amplifier is not really necessa and, if its amplification were elin nated, there would be enough sign leaking through the tube and wiri capacities to give a very satisfacto picture. This can be done by creasing the bias on the control g to the point where the tube amplif very slightly, if at all; likewise, the weak areas, the tube will ha maximum gain if the a.g.c. is short out.

Another important consideration the signal-to-noise ratio of the ceiver. This, too, is determined the r.f. amplifier since, in weak-sign areas, the r.f. amplifier must ampl the signal above the noise level the receiver in order to have a sno free picture. To accomplish all th the r.f. amplifier must have an a. curve like that shown in Fig. 5C. T a.g.c. for the i.f. stages must a vary with the signal strength, but as severely as the r.f. a.g.c.

All this is accomplished by utiliz a two-part a.g.c. system. The negat

**Fig. 5. (A) Simple a.g.c. circuit with its operating curve. (B) Voltage doubler type a.g.c. and curve. (C) Curve showing ideal a.g.c. for r.f. and i.f. stages.**






**. Simplified schematic diagram of
type a.g.c. circuit used by Emerson.**

ltage developed across the video
or load resistor serves as the
source for the i.f. stages only.
Fig. 6.) Since in the strong
areas the r.f. amplifier must
vely be cut off, or close to it,
gher a.g.c. potential is developed
e modified voltage-doubling ac-
f the second-section diode of $V_4$.
peak d.c. voltage will then add
e average voltage across the
resistor, giving the total voltage
he r.f. a.g.c., reducing the r.f.
in the high-signal area. For
signals, the action of the modi-
oltage doubler is reduced by ap-
; a positive voltage through
0-megohm resistor from a posi-
0-volt source, reducing the r.f.
to some value close to zero. If
ode section of $V_9$ were removed
the circuit while receiving a
signal, the r.f. a.g.c. line would
sitive. The a.g.c. clamper diode
nts this from occurring by con-
ng whenever there is a tendency
positive voltage to exist on the
.g.c. line. Actually, this a.g.c.
ill never become positive, due to
ontact potentials of the diodes,
ill always be approximately —.5
with no signal received.
low value of negative voltage
be present on the r.f. a.g.c. line
the signal is strong enough to
op a large enough bias in the
diode circuit to overcome the
ve delay voltage from the 80-
source. From that point on, the
voltage will rise very rapidly
e signal increases, crossing over
f. a.g.c. bias point (see Fig. 5C)
for very strong signals, cutting
e r.f. amplifier.
e vertical oscillator frequency is
olled directly by the vertical
pulse after it is integrated by an
oved integrator network. This
oved integrator is made up of two
ons of a low-pass network, $R_{94}$,
$R_{96}$, $C_{71}$, and $C_{72}$, rather than the
mary three sections. Also, the in-
impedance is lower which makes
operation more successful, since
noise or horizontal pulses that
induce currents into the vertical
it will develop a negligible volt-
across the low resistance of the
rator. Another important factor
at, with the two-section integra-
the time constant is shorter,
fore permitting the vertical sync
to discharge fully after the ver-

tical pulses are removed, within the time interval of the equalizing pulses. This arrangement permits improved interlace, allowing the receiver to have its maximum resolution and resulting in better picture quality.

The horizontal sync circuit uses the latest type of horizontal phase-detector circuit as an automatic frequency control. As seen from the schematic diagram in Fig. 4, the horizontal multivibrator ($V_{13}$) frequency is not controlled by pulses, as is the vertical circuit; instead, a d.c. control voltage is applied to its grid from the output of the phase detector. This voltage is negative or positive, depending upon the relation of the multivibrator frequency to the horizontal sync pulse. Increasing the horizontal frequency, or to be more correct, its phase, is accomplished by making the grid of the first half of $V_{13}$ more negative, decreasing its gain, but resulting in an increase in horizontal phase. To decrease the horizontal phase, a positive voltage is applied to the grid.

## Noise Inverter Circuit

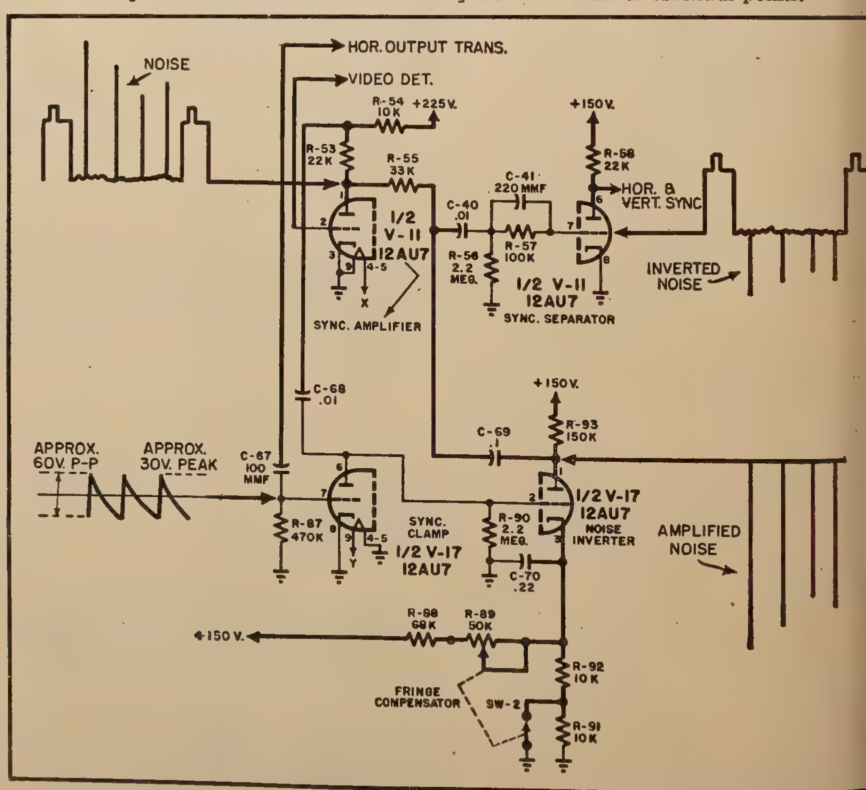
To improve the noise immunity of the circuits, early receivers used a noise clipper diode. The noise was clipped by the diode action down to the level of the sync peaks, at best, if the circuit was adjusted properly. The remaining noise pulse below the sync level, however, could still cause unstable sync. Also, under continuously heavy noise bursts, the noise clipper tended to build up a bias across it equal to the noise peaks and, therefore, was not effective for the elimination of such noise.

The *Emerson* noise inverter circuit, Fig. 7, not only prevents the noise from exceeding the sync peaks, b also reverses the polarity of the noi pulses into the negative region, whe they have absolutely no detriment effects on the sync circuits. It shou be noted that the noise inverter ci cuit will function on noise in the sy circuit only, and not in the video ci cuit. Noise appearing at the outp of the video detector will appear the picture tube.

The normal path of the sync pulse with the noise inverter inoperativ would be from the video detect through the sync amplifier, throug an *RC* noise-immunity circuit to t sync separator and, finally, to t horizontal or vertical sync circuit In operation, one-third of the outp voltage of the sync amplifier is tak off from the junction of resistors R and $R_{54}$, and is applied to the grid the noise inverter. The variable r sistance, $R_{89}$, which is part of a vol age divider in the cathode of the noi inverter, is adjusted so that the bi of the tube is just at cut-off when signal is received. The total bias the grid of the noise inverter mu always be equal to the cut-off bias the tube, plus the peak voltage of t sync pulses. The latter varies fro scene to scene, and is coupled to t noise inverter grid. A varying bi voltage that will follow the sync an plitude variations is developed on t grid, due to the action of the sy clamper in the following manner.

Pulse voltages, which are a fun tion of the horizontal frequency, a obtained from the horizontal outp transformer and are applied to t grid of the sync clamper at the sar instant that a horizontal sync pulse applied to the plate of the clampe

**Fig. 7. Noise inverter circuit showing the waveforms at essential points.**



-leak bias will develop on the clamper from the grid pulses will keep it cut off between tal pulses. When the clamper pes conduct, it charges $C_{68}$ up to ak voltage of the sync pulses , and its discharge through $R_{90}$ ps a bias voltage equal to the f the sync pulse. Adding the e developed across $R_{90}$, and the e in the cathode circuit of the nverter, results in the total bias e tube, maintaining it at the cut-off potential.

n the clamper does not conduct, ears as a high impedance per- g the noise pulses to overcome as on the noise inverter, driving conduction. These noise pulses mplified and appear across the -ohm resistor, $R_{55}$, with an oppo- olarity and greater amplitude the same noise coming from the of the sync amplifier. The latter pulse is therefore cancelled com- y, and appears as a negative- noise pulse having no harmful s anywhere in the sync.

hough the setting of $R_{89}$ is not itical, care must be taken so as develop excessive or insufficient With excessive bias, not all of oise will cause the tube to con- and this will result in inadequate llation. With insufficient bias, is the possibility that the sync will be cancelled, adding to sync bility. This variable resistor is the "fringe compensator con- and its adjustment is simple it is rotated until noise does not any sync instability of the pic- n the screen. If the fringe com- tor operation is not desired, the l is rotated fully counterclock- until $SW_2$ is opened, removing the across $R_{91}$. The increased volt- rop across the additional 10,000- resistor biases the tube well be- cut-off.

## Alignment Data

aid the service technician in ng the horizontal oscillator, leads the multivibrator phase coil and from the grid of the hori- l oscillator are brought up to a ny lug on the top rear of the is. Since the multivibrator con- grid must be at zero voltage for tion at 15,750 cycles, the lug con- d to the grid is simply shorted jumper to the chassis of the ver. Another jumper is used to out the other two closely-wired from the phase coil to each other. all controlling elements of the ator are removed, leaving the al $RC$ time constant. The hori- l hold control, $R_{73}$, located on the of the chassis behind the hinged *son* name plate, is adjusted so it is in the center of its mechan- range. With the set tuned to a l, the horizontal balance control, ocated on the rear of the chassis, justed so that the picture does ear. Next, the jumper shorting ugs connected to the phase coil is

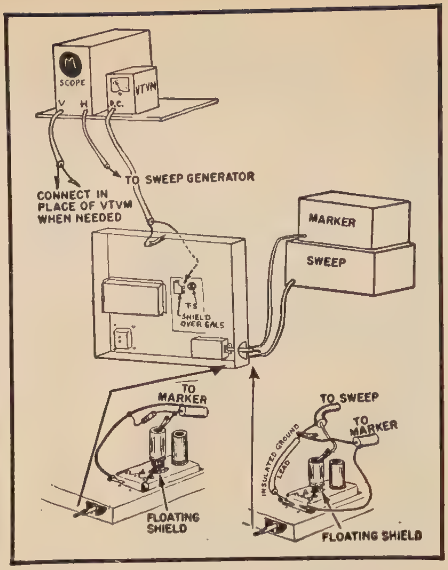



**Fig. 8. Test equipment setup for video i.f. alignment outlined in Table 2.**

removed, and the phase coil is adjusted so that the picture does not tear.

*Note*: Since no a.f.c. voltage is being applied to the multivibrator during the above adjustments, the horizontal blanking bar may move back and forth across the face of the picture tube.

To complete the adjustment, the jumper shorting the grid of the multivibrator is removed. The horizontal hold control should hold over the entire range if it is rotated slowly. If the horizontal should tear at only one end of the control, it is still within engineering specifications.

Before aligning the video i.f. stages of the receiver, do the following:

*a.* Tune the receiver to unused Channels 10 or 12.

*b.* Connect the negative terminal of a 3-volt bias battery to the i.f. a.g.c. This connection should be made at the junction of $R_{10}$, $C_8$, and $R_{16}$ (see Fig. 4). Connect the positive terminal of the bias battery to the chassis.

*c.* Raise the shield of the 6J6 converter tube, $V_{23}$, slightly so that it does not make contact with the chassis. (See Fig. 8).

*d.* The output cable of the sweep and marker generators should be properly terminated in their characteristic impedance (usually 50 to 75 ohms). If this termination has not been built into the end of the cable, connect a resistor of the same value as this characteristic impedance across the output of each generator cable, as shown in Fig. 8.

*e.* Proceed to step 1 on Table 2. —30—

## HAM CLUB ELECTS

**MILWAUKEE Radio Amateurs' Club has named K. W. Eggert, W9MOT, president; Dr. G. P. Lawrence, W9RZJ, first vice-president; C. W. Thomas, W9WK, second vice-president; W. E. Herzog, W9LSK, secretary; and E. J. Belanger, W9MDG, treasurer for the year 1953-1954. Four directors were also elected.** —30—

## TV High-Voltage Supplies

*(Continued from page 49)*

The resistance from the plate cap the output tube to the low end of t flyback transformer will probab range from 15 to 60 ohms.

If the click and spark are not c tained, the output stage is either c fective, the boost voltage is absent, the output stage is not being driv by the horizontal oscillator circui This now requires the use of te equipment to locate the trouble.

Use a vacuum-tube voltmeter measure the bias between grid a cathode pins on the output tube. An thing less than 20 volts is indicati of insufficient drive. If approximate 30 or more volts is obtained, che the damper by measuring the bo voltage at its cathode. If the bo voltage, which is usually a little l than twice the "B+" voltage, is obtained, the damper stage or the f back transformer may be defecti Make sure, of course, that the hi voltage fuse (if there is one) is blown. If the aforementioned te fail to locate the defective part, us scope to check the waveshape at grid of the output tube. Since t is a qualitative analysis and waveshapes differ from receiver receiver, it is difficult to give a h and fast rule as to what to look However, Table 1 contains the g waveshapes and potentials obtai for a number of representative ceivers. Failure to obtain these wa shapes and/or potentials indicates t the trouble lies between the grid cuit of the output stage and horizontal oscillator circuits.

There are many troubles that do cause the complete loss of high v age, or which affect the width, line ity, etc. Among the most comm troubles of this type are the foll ing.

*Picture Blooming*: Due to a ga high-voltage rectifier tube. Repl the tube, and if a doubler circui used, replace both rectifier tubes.

*Insufficient Width*: Caused by w low-voltage rectifiers, or a weak put tube. Check the output tube ca ode bypass if one is used. Also, ch the screen grid components. If linearity on the left side of the scr is affected more than on the ri check the damper tube and associa components. Check the boost volt and the boost filter, such as the µfd. condenser connected to the dam cathode (see Fig. 3).

*Output Tube Requires Frequent placement* (more than once a ye Check the grid coupling condenser may be leaky, causing excessive current to be drawn. Also, check grid waveform to make sure that tube is not being overdriven. In ei case, a check of the bias will reve the tube is drawing excessive current.

In cases where the trouble has traced to a defective flyback tr

it is very important that an replacement be made if addi- troubles are to be avoided. direct replacement sometimes ot work properly due to the hat aging of components, or a is incorrect substitution of may have produced operating ions which are so far off toler- hat the rear apron controls can ger reset the circuit for the de- esults. Some of the more com- troubles resulting from such tches, and the cures for them, scribed below.

fter replacing a flyback, insuf- width results, try shunting the coil with a condenser whose is between .025 to .05 $\mu$fd. An- method is to increase the out- be coupling condenser in incre- no higher than 10%, or to de- the value of the screen drop- esistor in steps no higher than or combinations of both. If the voltage is too low, reduce the tance across the width coil in ments of 20%, or increase the and/or screen voltage as de- d for insufficient width. If ex- high voltage is obtained, re- the drive to the output-tube by decreasing the size of the ng condenser, or increasing the f the screen-dropping resistor. s fails, insert a 1000 ohm, 10 potentiometer in series with the de of the flyback and the "B+" . Adjust the pot until the high e is reduced a sufficient amount. ve the pot and substitute a 10- fixed resistor of a value de- ned experimentally.

lternate light and dark vertical modulate the raster, check the er stage and the drive to the grid output tube. If parasitic oscil- s develop, insert a 47- to 68-ohm g resistor in the grid circuit of tput tube, and a 68- to 82-ohm or in the screen circuit. Para- can also be suppressed by means magnet clamped to the output or by redressing the leads con- d to the flyback transformer. If rizontal foldover develops, first the horizontal a.f.c. circuits for ct adjustment, and then check width and linearity components. try substituting a number of ent output tubes to obtain the hat matches best. —30—

## HAMFESTERS' PICNIC

**Hamfesters Radio Club of Chicago hold its annual picnic and air- le meet on August 9th at Mance ¼ mile east of Route 45 and ¼ south of Route 66 (Stinson Air- . Free parking of planes at Stin- irport will be available but pilots bring their own tie-downs.**

**od, ice cream, and beverages will be able at the picnic grounds. A full ram has been planned for the whole ly.**

**ckets are available from John J. , W9GVO, 4460 Oakenwald Ave., go 15, Ill. A donation of $1.50 is ested from those planning to attend ffair.** —30—

# RADIO-TV Service Industry News

### AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

TO MANY of those who attended the annual electronic parts and equipment trade show in Chicago last May, the most significant development in new products introduced was the *RCA* "TV-Eye" and the *Radio Corporation's* new plan for distributing it.

The "TV-Eye" is a new camera for closed-circuit applications. Its significance as a new product stems from its price of less than one thousand dollars. The special importance of *RCA's* plan of distributing is that the "TV-Eye" will be sold through regular parts distributing channels. Installation, maintenance, and service will be handled by the selling organizations or independent service companies.

"You may logically ask—"Why is this development especially significant?"

To answer that question for you we would like to first review what David Sarnoff, chairman of the board of the *Radio Corporation of America,* said about industrial television in his speech before the IRE convention in New York City last March:

## Industrial Television

"In a few short years we have seen television develop into a major factor in American life. Its extraordinary potentialities for political education, cultural instruction, and entertainment have been amply demonstrated. However, many other applications of television's basic function—extension of human sight—are ready for practical use.

"Thus far, the phenomenal growth of broadcast television has overshadowed these other applications which operate over closed-circuit systems and constitute the growing field of industrial television. The opportunities for expansion of television in this field are wide.

"Wherever danger, remoteness, or discomfort preclude the presence of a human observer, the industrial television camera can take his place. Handling of explosives, pouring of castings, watching the operations of furnaces, and remote power sub-stations are examples of television's usefulness to industry.

"As yet only a negligible fraction of the potential of industrial televisi[on] has been tapped. The major obstac[le] has been cost. That obstacle is bei[ng] overcome by lightweight equipmen[t.] *The dimensions of industrial televisi[on] may surpass the growth in broadca[st] television we are now witnessing* (Editor's note: italics ours.)

"Tomorrow we will demonstrate much simplified closed-circuit tel[e]vision system, which provides a Vid[i]con camera attachment for a stan[d]ard home television receiver. The sim[]ple attachment is connected as easi[ly] to a television receiver as a recor[d] player and does not affect the norm[al] use of the receiver in any way. Wi[th] the addition of this camera unit ever[y] one of the 23,000,000 television r[e]ceivers now in use becomes potential[ly] a closed-circuit system for schools, t[he] home, and other places.

## TV in Schools

"Schools, in which television sets a[re] becoming more and more a standa[rd] classroom fixture, may employ th[e] TV sets to bring talks and demo[n]strations to the entire school or selected classes, without the loss time or the confusion attendant up[on] a call to assembly. On college ca[m]puses the linking of the lecture ha[lls] by television will permit exchange instruction between departments, ac[cord]ing to the variety and interest of t[he] courses. In biological research a[nd] technical education, this form of te[le]vision has proved a valuable tool.

"The availability of a simple clos[ed] circuit system will put the televisi[on] microscope as a new instrument instruction within reach of every hi[gh] school and college in the country.

"Until now industrial television h[as] been utilized mainly by larger busin[ess] and industrial organizations, but t[he] reduction in cost brings it wit[hin] reach of thousands of small business[es.]

"Many uses are also foreseen closed-circuit TV in hotels, depa[rt]ment stores, and other business est[ab]lishments.

## Closed-Circuit TV in Homes

"One of the largest fields ahead the use of closed-circuit television the home itself. Closed-circuit sou[]

systems are familiar to Americans. We think nothing of voice communication between rooms in the same house, between offices in the same building, between upstairs and downstairs. We are destined, I believe, to become equally familiar with closed-circuit systems of sight transmission.

"When the cost of the camera attachments is sufficiently low to permit their use in the average home they may make the television receiver truly the control center of the home. The snap of a switch will turn the receiver from the broadcast program to view the children asleep in the nursery or at play in the yard, or the cooking on the kitchen range. The housewife will not only hear but see the caller at the door before she opens it."

Up until last Fall the cheapest "camera chain" available for closed circuit TV sold for more than four-thousand dollars. These units were sold directly by their manufacturers and were installed and maintained by factory service people.

Last Fall the *Dage Electronic Corporation* introduced a TV camera that carries a list price of $2850.00. When this camera was announced the *Dage Company* was literally swamped with inquiries about it, clearly demonstrating the tremendous interest already existing in the field of closed-circuit television.

In the span of less than a year's time closed-circuit TV camera systems have dropped in price from more than five-thousand dollars to less than one-thousand dollars. The most important factor in the cost of a TV camera is the price of the camera tube. The present list price of the Vidicon tube is around $400. *RCA* is said to be stepping up production of this tube and it is possible that production efficiencies and economies will result in a steady lowering of the price of this popular tube.

It is obvious that *Radio Corporation of America* visualizes closed-circuit television as a potentially immense business in its own right perhaps, as Mr. Sarnoff said, "even surpassing the growth in broadcast television we are now witnessing."

Last Fall, speaking before the NEDA convention in Atlantic City, Hal Bershe, renewal sales manager for the *RCA* tube department, told parts distributors assembled there, "Today, now, ITV is practical for millions of applications. Do you realize that in this statement we are suggesting that millions of television cameras may someday be placed in service? Have you considered the possibility of stocking Vidicon camera tubes, as you now do with 6L6's?"

### Importance to Service Industry

Many men operating TV service businesses have weathered the vicissitudes of the early "boom and bust" and subsequent periods of thoughtless service price cutting and user indolence to build stable business operations. Many of these men have ex-

panded the scope of their activities to handle other facets of service in the electronics field like AM-FM radios, auto radios, and mobile 2-way communications systems. In some cases, to level off seasonal fluctuations, these service executives have gone into home air conditioning, low voltage house wiring, and major appliance installation and maintenance.

It is for these businesses that closed-circuit television holds the greatest immediate opportunities. In most of our discussions of ITV we have dealt with monochrome systems. Substantial progress has been made in perfecting color TV equipment for closed-circuit work. Color TV has an especial appeal in medical applications and it is reported that one company is now in production on color TV cameras and monitors with the idea of aggressively exploiting the ready markets for this type of equipment. It is the plan of this organization to arrange for the installation, maintenance, and service of its systems by competent, independent TV service companies.

However, it is imperative that any TV service organization that wants to share substantially in the growth of closed circuit television must start now to prepare its personnel in both camera circuitry and application idiosyncrasies of this type of electronic equipment. Where it was possible to learn a lot about TV service and installation through 'cut and try' in the early days, closed circuit installation and maintenance will require expert technical 'know-how' right from the start.

## Hi-Fi Future

One of the most interesting developments in recent months is the announcement by such primarily radio and television firms as *RCA, General Electric, Admiral, Philco,* and *I.D.E.A.* ("Regency") that they are entering the high-fidelity audio equipment field. These and other companies are finding out, just as *Stromberg-Carlson* did almost a year ago, that there is a strong and ever-growing market for "packaged" high-fidelity systems or individual units which have been engineered to work together to produce the best results. These "matched" sets, which can be purchased at one time or added as the customer wishes, are gaining an enthusiastic acceptance among audiophiles.

The tremendous interest in high-fidelity reproduction that music lovers have shown during the past two years through their attendance at audio equipment shows in various parts of the country, indicates an ever-widening interest in custom-installed sound equipment in the home.

The bottleneck in the exploitation of the high-fidelity market has been brought about by the wide variety of methods employed in distributing the equipment which is of interest to the mass market of home owners. Service businessmen have not been interested in promoting custom-installed sound

equipment because after they ha
spent the money and time getting
customer interested in high fidel
equipment the customer will disco
where he can buy the units at dea
prices and either buy them hims
or drop the idea with the feeling th
the service dealer is profiteering
his expense.

In numerous instances service op
ators have shown your editors whe
after they had spent considerable ti
in detailing an installation of sou
equipment for a church or a comm
cial organization, the principals
volved bypassed them and bought t
necessary units from a local pa
distributor. In selling custom-instal
sound equipment it is necessary
give the customer a layout of wh
the units will be placed, how the w
ing will be accomplished, and deta
of the units that will be used in t
installation.

A novice to the hi-fi field, figuri
on an investment in custom-instal
equipment, quickly finds other hi-fi
thusiasts who know all the answer
particularly about where you can b
the elements for a high-fidelity syst
at the lowest cost. When that happ
the retail dealer who developed t
interest is out of luck. He does
have a chance to close the sale or
get any return on the time and kno
edge he has given in developing t
consumer's interest.

This situation has brought aggr
sive selling of high fidelity equipm
to a standstill at the consumer le

The unfortunate part of this sit
tion is that the tremendous mass m
ket for custom-installed hi-fi equ
ment will remain unexploited becau
of the lack of aggressive promotio
activity at local levels. The pres
hi-fi market is largely comprised
the audio enthusiasts in the half m
lion segment of our population w
are familiar with the elements
electronic circuitry.

This impasse may be broken so
day by some manufacturer or co
bination of manufacturers who set
sales programs for package sound t
will be available only through auth
ized dealers capable of installing a
maintaining it. A "package" of qua
equipment aggressively merchandi
to home owners would find a recept
market among the many thousa
who would appreciate the pleasu
of high fidelity sound without
bother of trying to understand how
is accomplished.

## Service Business Categories

When you speak of an electro
service business, the average man
visualize a one-man shop with
owner busy plying a soldering i
to the innards of an up-turned ra
or television receiver. But while
dustry attention has been direc
largely to the expanding base p
vided by new products and
extension of manufacturing and
tributing facilities, a great m
changes have been taking place

...sinesses devoted to the servic- ...electronics products. We felt it ... be of interest to our readers in ...vice business to know the many ...ries into which the activity has ...led:

...elevision (installation and serv-...e)

a) TV Service—dealer operated
b) TV Service—wholesale — for non-servicing dealers
c) TV Service—consumer only —complete service home and shop
d) TV Service—installations only—for dealers
e) TV Service—drive-in — customer brings set in —picks it up after service is completed.

...M-FM radio service
...hono service—automatic changer specialists
...uto radio specialists
...Vire and tape recorders
...udio equipment — (industrial ...nd commercial) — sales and ...ervice
...Iobile 2-way communciations ...quipment
...ndustrial electronics maintenance
...ommunity and apartment house ...V systems.

...heir travels about the country ...ditors have found several thriv- ...usinesses that specialize in the ...ing of wire and tape recorders. ...ype of equipment, now widely ...n businesses and by professional ..., has been passed up by most ...e operators. On the other hand, ...ypewriter sales store that went ...elling wire and tape dictating ...nes soon found the adjustment ...ervicing of recorders to be a ...able avenue that supplies a con-...t volume of business.

## ...Bulletins Available

...m time to time we have offered ...ins to our readers which cover ...is subjects of interest to people engaged in the service business. From time to time we get letters from readers asking for bulletins that were offered several years ago. Unfortunately, most of these bulletins are out of print.

At the present time we have the following bulletins available to those who would like to have them:

1. Financing a TV Service Business
2. Standard TV Labor Pricing Schedule
3. Your Market — Replacement phono needles, cartridges and changers
4. Closed Circuit TV—Opportunities for Independent Service Businesses.

In requesting bulletins address your letter to: TTLB Information Service, P. O. Box 1321, Indianapolis 6, Ind., and include an addressed, stamped envelope. Twelve cents in postage is required for all four bulletins listed above. —30—

## AMATEUR TELETYPE

**THE Southern California Radio Teletype Society, an amateur group, has been publishing a highly informative and professionally laid out bulletin called "RTTY" since January of this year. "RTTY" carries articles on amateur teletype equipment and techniques, reports on station and network activities, and supplies information on the availability of equipment, etc.**

**A page called "Tape off the Floor" gives interesting gleanings from conversations between amateur teletype stations all over this country and Canada. The SCRTS and "RTTY" plan to make an "Amateur Radio Teletype Handbook" available late in September.**

**Subscription to "RTTY," which is non-commercial and non-profit, is not restricted to SCRTS members and may be had by anyone for $1.80 a year, which covers the cost of printing and mailing. Further information may be obtained from Merrill Swann, W6AEE, at 3769 East Green Street, Pasadena 10, California, the address of the Society.** —30—

**...ver-all view of the manufacturing area of Allen B. Du Mont Laboratories' new ...strument Division plant in Clifton, N. J. The new facility contains 118,000 square ...et of space for the development and manufacture of cathode-ray instruments.**

## Mac's Service Shop

(*Continued from page* 66)

"It's not so strange. People are pretty meter-minded. The gas man measures the pressure delivered to the house with a meter. The electrician uses a similar gadget on the mains. The garageman checks their car battery with a meter, and the local police may even, on occasion, use a meter to tell how many beers they have had. It only seems natural and businesslike to them that the TV service technician should have a device to measure the amount of signal delivered to the set."

"That meter does a fine job of checking set accessories, too," Barney remarked. "With it I can tell in a matter of seconds if a booster is boosting or not and how much. In the same way I can put it across the output of a u.h.f. converter and tell in a minute if the cause of poor u.h.f. reception lies in the converter or in the set. Along with this, of course, I employ the meter to measure the u.h.f. antenna voltage. Since we installed those u.h.f. strips in the meter's turret tuner, the gadget is just as useful on u.h.f. signals as it is on v.h.f. measurements. Some of those u.h.f. antennas have mighty sharp lobes, and you need the meter to line them up exactly."

"I was just thinking," Mac mused, "that we use the field strength meter around the shop for a lot of things besides the ones we've mentioned. For instance, I ran the signal generator into that two-set coupler we bought and then measured the output across the two receiver connections and found that one leg had twice as much output as the other. I used the meter again when I was building up that ladder-type attenuator so we might have as weak a u.h.f. signal as we want for checking fringe-area sets. The field strength meter tells me exactly how many sections to cut in or out to get just the signal strength required.

"It is also just what the doctor ordered for checking the output and attenuators of our sweep and marker generators. You will recall that we found our sweep generator could not be reduced to a very low level of output until probing around with a piece of twin-lead connected to the field strength meter showed that the r.f. was coming out on the line cord. After we put a line filter inside the case, that put an end to the leakage, and the attenuator worked as it should."

"Yeah, and that gave me an idea," Barney exclaimed. "I put a highpass filter on the input terminals of the meter and took it home with me to help track down some harmonic leakage in my ham rig that was causing TVI. With a short length of twin-lead terminating in a two- or three-turn coil for a probe, that field strength meter makes the most sensi-

harmonic indicator you could
for. Later I learned that Phil
in the June, 1952 issue of *"QST"*
how this very meter can be modi-
especially for running down TVI
stalling a coax connector and a
e of filters and by drilling a hole
e panel so the oscillator coils
be adjusted to cover an extended
e either side of the video carriers.
s able to track down my trouble,
h, without doing this."

am glad," Mac remarked dryly
e turned the channel selector
to make sure no holes *had* been
d in the panel.

on't forget the tests we made on
antennas and lead-ins," Barney
"You had me up on the cold,
roof connecting identical lengths
arious kinds of lead line to the
nna and pouring water down
them while you sat here in the
warm shop tabulating relative
strength readings."

ell, you were the one who
dn't trust the attenuation figures
in the books," Mac retorted;
then our findings were almost
ical with the published ones. One
worthwhile we did find out,
gh, was which of the various
ls of matching transformers used
connecting a v.h.f. and a u.h.f.
nna to a single lead-in were the
By connecting the lead first to
u.h.f. antenna and then to the
antenna and noting the relative
l strength received, and then by
the various types of matching
formers one at a time and tak-
ew u.h.f. and v.h.f. readings, we
clear picture of the effect each
former had on the two signals."

he thing I like about using a field
gth meter is that it teaches you
kind of performance to expect
of each brand of receiver," Bar-
said. "That is important in this
that is ultra-fringe v.h.f. but
ary u.h.f. since we got our new
on. While I realize this meter is
ntended to measure received sig-
strength in absolute microvolts—
a job would cost several thou-
s of dollars—it is a very depend-
indicator of relative signal
gth. Using it, we have learned
we must have a reading of ten
fteen microvolts to make some
hold sync, while others will hang
in there down to two or three
ated microvolts. Certain models
be snow-free when our meter
s 100 microvolts; others take two
ree times this amount. Knowing
to expect out of a set is dog-
important, but first you have to
what goes into it."

hat's right," Mac agreed. "The
l is what the technician has to
with, and with a good field
gth meter he can trace it be-
the antenna terminals right up
e antenna itself. Considering the
rtant part that the antenna plays
V reception, I should say that was
tial."

—30—

# SERVICE HINTS ON EMERSON TV SETS

**CHASSIS 120094A**

*60-cycle buzz.*

To eliminate such buzz from the audio when it is present even at low settings of the volume control, do the following:

1. Dress all leads to the picture-tube socket as far from the 6T8 tube as possible. This can be done by securing the green grid lead wire to the side of the cabinet.
2. If the buzz persists, realign the sound circuits and sound traps.

**CHASSIS 120095**

*Bright noise streaks.*

To eliminate such disturbances from the picture, remove the 22-ohm resistor connected between the tuner frame and "B—", and replace with a jumper wire.

**CHASSIS 120095B**

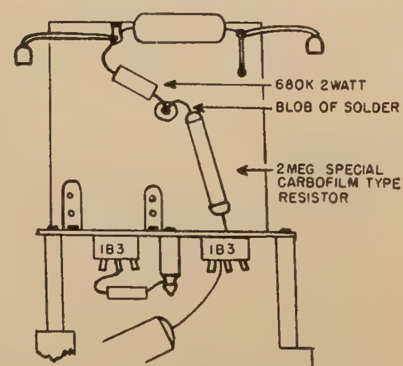
*Audio buzz.*

Change condenser $C_{15}$ (1500 $\mu\mu$fd.) to a 220-$\mu\mu$fd. unit. This is the cathode bypass condenser of the sound mixer tube ($V_4$, 12AT7).

**CHASSIS 120109 & 120120**

*Replacement of the 2-megohm high-voltage resistor.*

This resistor is $R_{30}$ in the 120109 chassis, and $R_{46}$ in the 120120 chassis. When replacement of these resistors becomes necessary, a 680,000-ohm, 2-watt *Allen Bradley* resistor should be placed in series with the new 2-megohm unit. No substitutes should be used for either one of these resistors. The




method of mounting is shown in the accompanying diagram.

The junction of the two resistors should be looped, and a large blob of solder should cover any points or sharp ends. This prevents ionization of the air, or arcing.

**CHASSIS 120118B**

*Loss of horizontal sync.*

1. Replace the horizontal oscillator and control tube (V 12SN7GT).
2. Replace $C_{47}$ (.002 $\mu$fd., 400 vo condenser with a 600-volt u of the same value.

*Bad arcing in raster, small irregular ras*

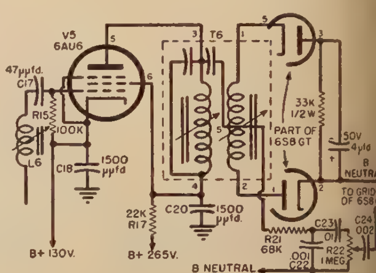
Replace $T_7$ horizontal oscilla and phasing coils.

**CHASSIS 120123B**

*Intercarrier buzz.*

To eliminate this condition, do t following:

1. Remove the following comp nents from the circuit:
   a. $C_{21}$ (110 $\mu\mu$fd.) connect




   between pin 5 and pin 2 $V_6$ (6S8).
   b. Resistors $R_{19}$ and $R_{20}$ (10 000 ohms) from lug 5 $T_6$, the discriminator tra former. (Lug 1 has a gre dot, lug 3 has a blue d Numbers run countercloc wise.)
   c. $R_{16}$ (8200 ohms) and (1500 $\mu\mu$fd.) from pin 6 $V_5$ (6AU6).
   d. $R_{18}$ (2200 ohms) from t "B+" point on the ter nal strip to lug 4 of $T_6$.
2. Reconnect the following co ponents:
   a. Remove pigtail of $R_{21}$ (6 000 ohms) going to pin 5 6S8, and connect to lug of $T_6$.
   b. Remove lead from pin 3 6S8, and connect to pin
   c. Add a jumper wire fr lug 4 of $T_6$ to pin 6 of 6AU6.
3. Add the following componen
   a. A 33,000-ohm, ½-watt sistor in parallel with 4-$\mu$fd., 50-volt electroly condenser, from pin 3 the 6S8 to "B neutral" the nearby terminal bo (second lug from tune with the negative side electrolytic to pin 3 of 6
   b. Add a .001-$\mu$fd., 400-v condenser from pin 6 of 6S8 to "B neutral."

The accompanying diagram ab shows the new circuit.

Align the sound circuits as follows:

a. Place a d.c. v.t.v.m. (negative scale) across the 4-μfd. electrolytic, ground terminal to "B neutral" (plus side of electrolytic).

b. Tune in a good television station.

c. Adjust $L_6$ and primary of $T_6$ for maximum meter deflection.

d. Remove meter and adjust secondary of $T_6$ for maximum sound with minimum buzz. (The secondary of $T_6$ is on top for Part No. 708018; on bottom for Part No. 708017.)

**IS 120124**

*erference on AM radio sets in vicinity.*

nstruct a filter as follows: onnect a .05-μfd., 400-volt condenser in parallel with a 100,000-m, 1-watt resistor from the line itch side of the a.c. input plug ground.

*stable sync due to internal radiation.*

eliminate the effect of internal diation on synchronization cirits of the receiver, do the folwing:

Add a 1500-μμfd. condenser from the "B+" side of fuse, $F_1$, to chassis. (Keep the leads about ¼" long.)

Add a metal shield 4" long, 2" wide, along the side of the i.f. dummy lug strip.

Change condenser, $C_{73}$, from 50 μμfd. (mica) to 42 μμfd. (ceramic, 2000 volts).

Change condenser $C_{91}$ (18-μμfd., 6000-volt mica) between the plate of the 6BG6 tube and chassis, to an 18-μμfd., 6000-volt *ceramic* unit.

**IS 120127B & 120128B**

*eck shadows.*

a shadow on the right-hand de of the picture tube persists ter the beam bender focus coil d the deflection yoke have been operly adjusted, do the following:

Reverse the electrical connections to the focus coil.

Magnetize the molded iron core in the deflection yoke as follows:

a. Remove $V_{15}$ (6BG6), $V_{17}$ (1B3), and $V_{16}$ (6W4) from their sockets.

b. Remove the white lead from the horizontal deflection yoke at the width coil (junction of $L_{11}$ and $R_{91}$, 750-ohm resistor), and connect to a "B+" 230-volt point (red lead on electrolytic condenser).

c. Connect the negative terminal of a spare 40-μfd., 450-volt electrolytic condenser to the chassis.

d. With the set operating momentarily, touch the posi-

tive side of this electrolytic to pin 3 of the $V_{16}$ (6W4, damper tube) socket.

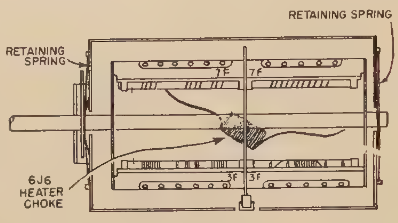
e. Remove the 40-μfd. electrolytic making sure to first discharge the positive terminal to the chassis to avoid a shock.

f. Replace tubes and reconnect yoke.

*Black vertical line at left of picture.*

This is generally caused by Barkhausen oscillations. After normal means (adjusting the horizontal drive condenser or changing the 6BG6) to eliminate this interference have been tried, and if the oscillation persists, do the following:

Break the cement which glues the 6J6 heater choke to the underside of the tuner chassis, and press this choke away from the chassis (toward turret). See the




accompanying diagram. This can be accomplished by removing both sets of coils for Channels 4, 5, 6, 11, 12, and 13, and then gently prying the choke loose with a screwdriver. Be careful not to damage or change the shape of the coil.

### CHASSIS 120142B, 120143B

*Horizontal foldover.*

This condition is characterized by white hash within the left quarter of the picture which varies with the setting of the horizontal hold control.

To cure this, do the following:

1. Replace resistor $R_{75}$ (220,000 ohms) connected through condenser $C_{52}$ (82 μμfd.) to pin 1 of $V_{15}$ (6SN7 horizontal control tube) with two 100,000-ohm, ½-watt resistors in series.
2. Connect a 25 μμfd. ceramic condenser from the junction of the two 100,000-ohm resistors to chassis ground.

*Raster comes on after sound (more than one minute later).*

This usually is the result of a slow-starting horizontal oscillator, and may be cured by the following:

1. Check the 6AX5 low-voltage rectifier tubes ($V_{19}$ and $V_{20}$). These may have low emission causing a low "B+" voltage.
2. Change the 6BQ6 horizontal output tube ($V_{16}$). It may be necessary to try a few tubes since some of these may have slow heaters.
3. Check $C_{60}$, the 10 μfd. "B+" boost filter condenser, and replace if leaky.
4. Check all solder connections in the 6SN7 horizontal osci lator and control circuits (V and $V_{16}$).
5. In low line voltage area change the value of $R_{86}$ (at p 10 of the CRT) from 22,0 ohms to 15,000 ohms.
6. Try a new horizontal pha coil $L_7$ and oscillator tran former $T_{10}$. These may ha shorted turns or may be ope ing intermittently.

### CHASSIS 120166D

*Vertical roll.*

When this occurs with the rece tion of noise interference, it m be corrected by replacing the 15 ohm resistor, $R_{86}$ (grid resist from pin 4 of 6SN7 vertical osc lator, $V_{15}$, to ground) with a 10 ohm unit.

*Hiss in fringe areas*

To increase the signal-to-noi ratio and reduce hiss in frin areas, change the value of ( (from volume control to groun from .001 μfd. to .002 μfd.

### CHASSIS 120166D, 120168D, and 12016 F, & D

*Picture wiggle.*

This may be caused by incorre lead dress of the picture tu leads.

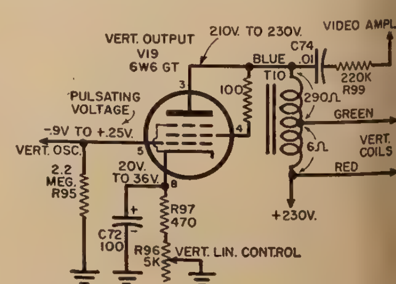
To correct this, do the following:

1. Dress the yellow lead to t cathode of the picture tu (pin 11) away from the ho zontal oscillator tube (V 6SN7) to prevent stray pick of video information by t oscillator tube. The yello picture tube lead can secured to the deflection yo support bracket.
2. Dress the white lead to t fringe compensator "on-of switch away from the ho zontal phase coil ($L_{11}$) and t grid of the 6SN7 horizont oscillator tube (pin 4 of $V$

### CHASSIS 120168D

*Popping sound in audio.*

When this condition occurs at t same time that the picture sta to roll vertically or when the ve tical hold control is adjusted, may be cured by installing a 10 ohm, ½-watt resistor between t




screen and plate of the vertic output tube ($V_{19}$, 6W6), as sho in the diagram.

*Hiss noise in fringe areas.*

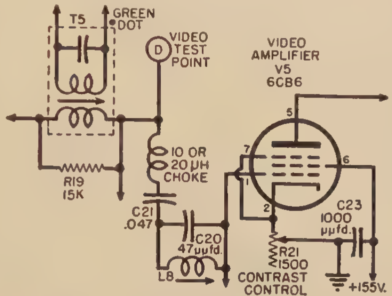
To reduce the amount of hiss, a a decoupling condenser to t

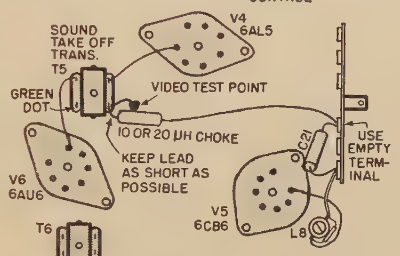
plate circuit of the 1st audio amplifier. This condenser should be .001 μfd., and should be connected from pin 7 of $V_9$ (6AV6) to chassis.

*Black horizontal streaks when tuned to Channel 6.*

This condition is usually only apparent in fringe areas, and is caused by harmonics of the picture i.f. generated in the video detector coupling to the front end, causing regeneration of certain frequencies. In many cases it may be tuned out with fine tuning, and can sometimes affect Channels 5 or 7.

These streaks may be eliminated by connecting a 10- or 20-μhy. r.f. choke in series with the .047 μfd. condenser ($C_{21}$) connected to the grid of the 6CB6 video amplifier tube ($V_5$). This choke should




be connected and dressed as shown in the diagram.

In some chassis, the 4.5-mc. trap ($C_{20}$-$L_8$) has been eliminated. This serves to improve the sound in fringe areas.

### CHASSIS 120168D, AND CHASSIS 120169B, F, & D

*Repeated fuse failure.*

This can be caused by momentary arcs in tubes or components which occur intermittently and soon heal themselves.

To cure such fuse failure, replace the burnt-out fuse with a 6-amp. slow-blowing type.

### CHASSIS 120169B & F

*Yoke ringing.*

This condition is characterized by a rippling of the horizontal raster lines at the left third of the picture.

To cure this effect, check condenser $C_{62}$ which is across part of the horizontal deflection yoke coil. If this condenser is bad, it should be replaced with a new 2000-volt unit between 38 μμfd. and 62 μμfd. (Try values between these limits for the best ringing elimination.)

—30—

## Film for TV

(*Continued from page* 37)

with a white light of equal intensity, the latter gives off a highly actinic blue radiation. Photographically speaking, this fits the bill since it cuts down on the all important film exposure time.

Early TV film recording utilized a shutter that opened 170°, resulting in an exposure time of about 1/30th second. By accurately synchronizing the camera motor it was then possible to make the shutter open and close during vertical blanking. With this experimental device, kinescopes were recorded at a 15 frame-per-second rate.

Currently in use, a 16 mm TV recording camera is phased to the system's synchronizing generator. Its shutter, driven by a 60-cycle synchronous motor through a set of precision gears, has a closing angle of 72°. At a 24 cps rate this is equal to a single TV frame. Thus, two and one-half fields occupy one-twenty-fourth of a second which is the equivalent of one frame of 16 mm film.

Since the top portion of field 3 is unexposed during the film pulldown period, it is made up later by exposing the upper portion of field 5, before the shutter again commences its action. Two fields are therefore fully exposed since the continuity of action is at such a rapid rate.

Accurate synchronization must exist at all times. Any change, however slight, in the speed of the shutter inevitably results in banding. TV recording engineers call this "shutter bar." This may sometimes occupy a space of some ten or twelve horizontal lines running through the center portion of the picture. They may be overexposed or underexposed and exist as an unpleasant pulsating optical phenomenon.

In order to insure an extremely high degree of shutter accuracy, today's drives are designed with the care and precision of a Swiss watch. The all-electronic shutter is, however, slowly gaining prominence in certain installations. The adjustments required with mechanical shutters present no problem in this system since no shutter is used.

Due primarily to economic considerations, the great majority of kinescope recordings will undoubtedly continue to be made on 16 mm film. Furthermore, fire regulations covering the use of 35 mm film are most rigorous. Consequently 16 mm technique in both kinescoping and film projection is undergoing vast improvement.

As to the future development of films and television, several noteworthy investigations are taking place simultaneously in Hollywood and Great Britain. Technically very little is known at this time regarding the video tape recording process of the Hollywood *Crosby* laboratories. Presumably pictures have already been produced from a rapidly moving spool of special tape!

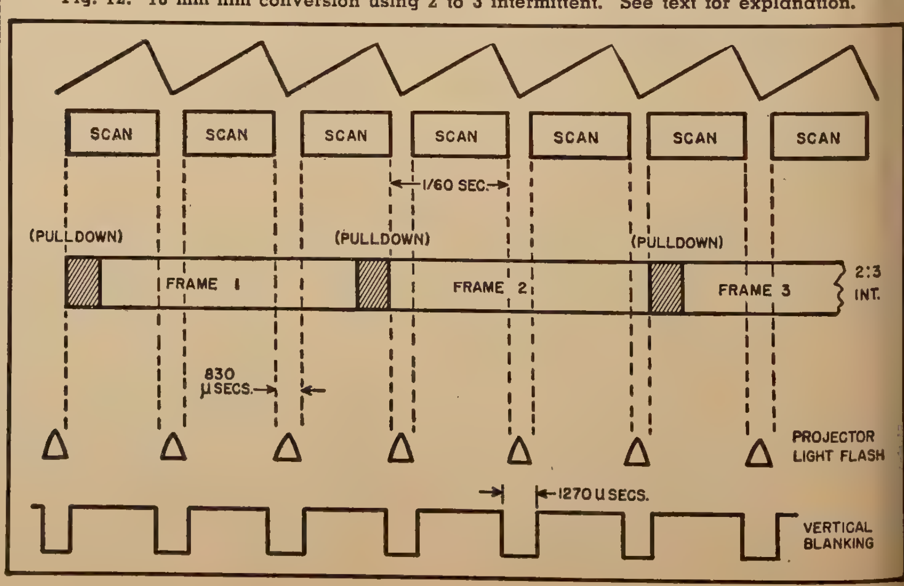
Engineers in England are well on the way towards perfecting a method that eventually will replace existing movie making techniques. In the filming of a movie, no one but the camera operator can have a true picture of what is actually taking place on the stage. His eyes see what the film sees. Consequently two, three, or even four different shots may be taken of the same scene. It remains for the director to integrate these.

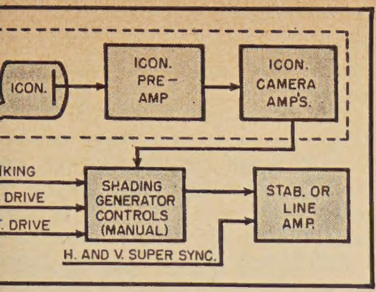
After processing hundreds of these, assembled clips are projected on a screen in the screening room. Within these confines the director selects, chooses, and rejects. This rather crude, though accurate, presentation is rather costly. Now if the director had an instantaneous prevue of several camera shots on location, similar to those on TV broadcast monitors, his problems would be simplified.

Let us have a "preview" of what might occur.

Once a director's decision is made

**Fig. 12. 16 mm film conversion using 2 to 3 intermittent. See text for explanation.**






elevision film camera control chain.

a particular shot it is commu- ed verbally to the technical su- sor, "Take Four." Camera #4 is ied up on the intricate dissolve- ing console and its picture trav- er a closed circuit to the record- kinescope) studio. Here it is re- d on fine grain high quality 35 tock.

cial effects such as "wipes," "dis- " and superimpositions present roblem. Modern TV techniques use of the latter two, hundreds nes throughout a single evening ansmission. As a matter of fact, on bridge was once "moved" into ther small TV studio *via* the od of rear screen projection!

bably the last technical hurdle n overcoming the limiting reso- of present-day camera tubes ecording kinescopes. In the writ- pinion an idealized experimental ach would be a closed circuit m capable of passing an over-all width of some 960 lines (12 mc.). mediate video amplifiers are to- commercially available with up , twelve, and even fifteen mega- response.

view of the fact that most of the transmission problems have been d with ingenuity, it is only a r of time until all the "bugs" been eliminated.

seems hardly fair to the already ering movie industry that tele- has been elected to deal the death blow. The film capital's t comeback is the three dimen- l (3D) medium. TV's answer well be as follows: "Not only are oday experimenting with three nsional color television, but we ose to have our pictures broad- on an international scale." Truly s been said, "In anticipation of rrow's miracles lies the inspira- of today's engineer!"

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## Choosing a Probe

(*Continued from page 42*)

that the time constant of its output is short enough to pass audio frequencies.

The demodulator probe is primarily intended for observation of sweep curves and audio waveforms. In responding to the modulation envelope of an r.f. carrier, this probe is capable of accurately following the complex waveforms conveyed by modulation. The demodulated output of the probe can be measured as an a.c. voltage on a "VoltOhmyst" or it can be observed as an audio waveform on an oscilloscope. The output range of the WG-291 is flat from d.c. to 5000 cycles and, therefore, includes both the high-frequency and low-frequency components of a 60-cycle square wave, making this particular probe especially good for the observation of sweep curve response.

The input frequency response of this probe is flat from 500 kc. to 250 mc., enabling it to demodulate any video, i.f., and TV channel sweep frequencies or audio amplitude-modulated carriers within that range.

Because of its low input capacitance of 2.25 μμfd., the WG-291 demodulator probe can be used to observe video sweep curves or to observe i.f. amplifier curves at any stage. It is very handy for signal tracing and trouble-shooting whenever modulated carriers are present, and it is particularly helpful in locating causes of hum modulation.

When the demodulator probe is used with an oscilloscope equipped with a d.c. blocking condenser, a demodulated waveform will appear at the normal vertical centering location. When used with an oscilloscope having a direct-coupled amplifier and direct-coupled input, the demodulated waveform is displaced in a positive direction by an amount proportional to the r.f. carrier level. When an unmodulated carrier is applied to the probe and its rectified output is applied to a d.c. scope, the trace is displaced in the positive direction by an amount equivalent to the peak value of the carrier.

The WG-291 demodulator probe is a peak-rectifying type which produces right-side-up video curves on any oscilloscope which is correctly polarized for upward deflection from a positive voltage.

### Multiplying Probes

Safety is the prime consideration in the design of the *RCA* WG-289 high-voltage probe. The probe itself is a housing for a high-resistance multiplier and is shaped to minimize leakage and corona.

A 1090-megohm multiplier in a WG-289 high-voltage probe used in conjunction with a "VoltOhmyst" having 10 megohms internal resistance provides a convenient 100-to-1 voltage reduction for all d.c. ranges. The ex-tremely high resistance causes n ligible loading on TV high-volt supplies.

If it is desired to measure 19 k volts with a high-voltage probe, "VoltOhmyst" should be set on 500-volt range to read 1.9 on th scale. The meter reading is then times 100 or 190 volts. This, in tu is multiplied by the probe factor 100 to indicate a total of 19,000 vo

In a unique application of the hi voltage probe, the waveforms of 15 kc. television horizontal-output a high-voltage circuits can be viewed an oscilloscope provided that the sc has a d.c. path to ground of appro mately one megohm in series with probe resistance. Signal tracing a waveform analysis in high-voltage c cuits are thereby made practical. T type of probe is not recommen for exact a.c. measurement because stray capacitance pickup. It is advisable to shield the multiplier sistor because shielding would red the safety factor.

—30—

## NEW DIODE FOR U.H.F. TELEVISION

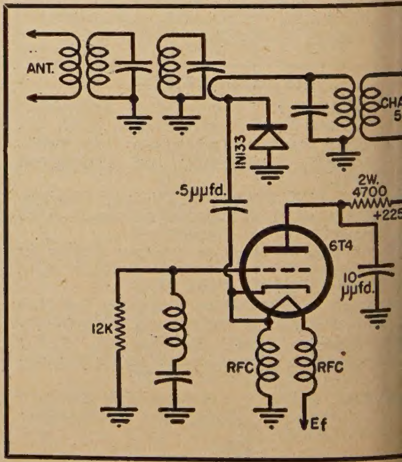
**CBS-Hytron has introduced a new g manium diode which has been es cially designed and tested for mi applications in the u.h.f. television sp trum from 470 to 890 megacycles.**

**The new Type 1N133 is housed i glass-filled phenolic case and is es cially impregnated to insure optim performance under adverse humid conditions.**

**Maximum ratings at 25° C. includ d.c. inverse voltage of 5 volts, a ma mum (average) d.c. current of 50 m a maximum d.c. peak current of 1 ma.; surge current (1 sec. duration) 500 ma. Typical characteristics at 25° include: maximum reverse current —.6 volt) of .3 ma.; minimum forw current (at +.5 volt) of 3 ma.; av age shunt capacitance of .8 μμfd.; peak inverse voltage of 6 volts.**

**The germanium diode's mixer ch acteristics in the u.h.f. television circ shown include oscillator injection o ma., frequency of 850 mc., average c version gain of .5, and an average n figure of 16 db.**

The new CBS-Hytron Type 1N133 german diode used as a u.h.f. television mi



## Crystal Calibrator

(*Continued from page 63*)

band the better, as the beat note in the receiver is S-9 on the fundamental. An 80-meter crystal gives strong beats from 160 to 10 meters and is also usable on the higher bands. Decide how many crystals you want to use in this application, and with an appropriate switch, if more than one crystal is used, wire up the unit in 30 minutes. Note that the tube terminals shown in the schematic are for a 6V6.

A crystal with its fundamental frequency in any amateur band can be used for checking purposes on all of the ham bands since the circuit is rich in harmonics and subharmonics.

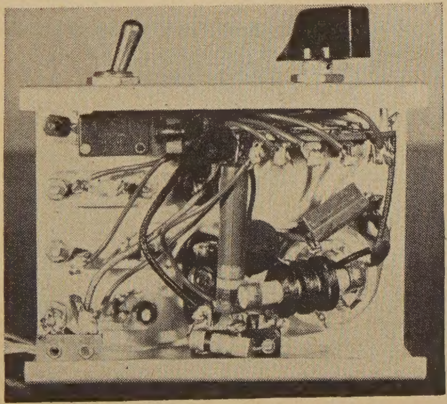
No r.f. connection to the receiver is necessary. Merely place the unit in a convenient location anywhere in the shack, or inside your receiver, if desired, and when you snap the switch "on," there is your checking signal.

The author usually operates near 7100 kc., and the crystal generally used is 3560 kc., giving a fine marker at 7120 kc.

Most modern crystals are accurately calibrated and reasonably drift-free in this application. Some of the surplus crystals available at bargain prices may be of a slightly different frequency from that stamped on the holder. It would be wise to check their frequencies before depending on their accuracy. If your receiver is equipped with a vernier on the h.f. oscillator (like the modern *HRO* series) or an adjustable dial (like the *Collins*), setting it on frequency is easy and accurate. With other receivers, it is easy to interpolate mentally. If the calibrator gives a 7150 kc. signal, and zero beat on the crystal shows 7145 kc. on the receiver dial, it is obvious that within the range of 100 kc. or so, your receiver calibration is 5 kc. low.

Be sure and check the calibration every 10 or 15 minutes for the first half hour warm-up, as most receivers drift and they all vary somewhat from day to day due to differences of temperature and humidity in the shack and due to "aging" of components, as previously mentioned.

**Underchassis view of the junk-box calibrator shows easy wiring of the few parts.**



FCC rules provide that some method external to the transmitter be provided to insure that operation is within the assigned bands. This unit is a "natural" for this job. Establishing your receiver frequency and then zero-beating the transmitter with the receiver insures operation within the law.

The unit will be found valuable for other purposes around the shack. Adding a .0001 μfd. condenser as shown in dotted lines on the circuit diagram gives you an exciter and keeps you on the air while you rebuild your v.f.o. and you have a choice of six frequencies at the turn of a switch, if your unit is constructed similar to the a thor's. If you have a crystal of proper frequency the 455 or 456 subharmonic or any other desired su harmonic can be used for alignment the receiver i.f. By itself, the unit a fine low-powered transmitter emergency use, with a key in negative high-voltage lead. Power c be supplied by batteries if necessa and the antenna may be connected the dotted line point in the diagra Dozens of other uses will come mind. All in all, it will turn out to a handy gadget around the shack. will be well worth the time and mon involved in its construction. —

## COMPACT FILAMENT AND SHORT CHECKER

By ROBERT BAXTER

**THIS checker can be built with a minimum of time and expense and will test filament continuity on all types of 7-pin miniature, 9-pin miniature, octal, and loctal tubes.**

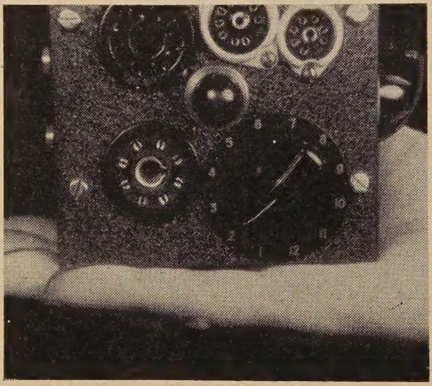
**Shorts may be checked between any two elements of any of the above-mentioned tube types.**

**Two pin jacks have been provided for test leads which may be used to check continuity externally. When using test leads, a condenser, $C_1$, is used to prevent direct contact between the a.c. line and the user's body.**

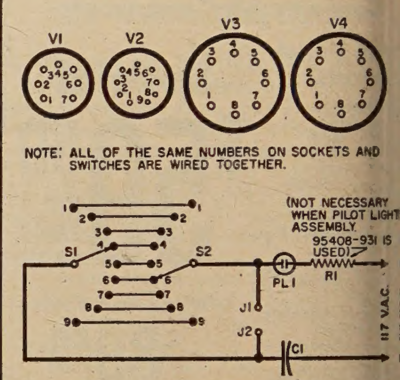
**All socket pins of the same number are wired together. These pins are then wired to the corresponding number on both selector switches. This combination makes it possible to select any two elements for checking.**

**Modifications may be made which will effect some economy including the use of wafer-type tube sockets, a less expensive pilot light socket, etc. A small wood ca net could be used in lieu of the me unit.**

**The selector switches have twelve po tions, of which only nine are used. It necessary to remember that when testi for continuity externally, the select switches must be switched to differe numbers.** —



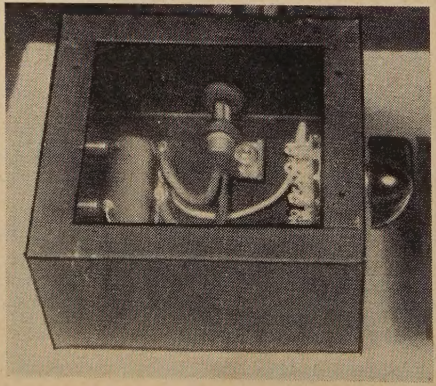
Over-all view of filament and short checker.




*$R_1$*—2 megohm, ½ w. res.*
*$C_1$—.1 μfd., 600 v. cond.*
*$J_1$, $J_2$—Phone tip jack*
*$PL_1$*—NE-51 neon lamp*
*$S_1$, $S_2$—12-pos. selector sw. (Yaxley 31112J— 9 positions used)*
*$V_1$—7-pin miniature socket (Eby)*
*$V_2$—9-pin miniature socket (Eby)*
*$V_3$—Octal socket (Amphenol 78RS8)*
*$V_4$—Loctal socket (Amphenol 78RS8L)*
** If a pilot light assembly (Dial Light Con pany of America #95408-931) is used, r sistor $R_1$ can be omitted as it is built into th assembly.*

Schematic and parts list for test unit

Rear view of the compact and handy tester.



Under chassis view showing the wiring